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THE DISTINCTION BETWEEN ANIMALS AND PLANTS.

BY J. C. ARTHUR.[1]

The animal kingdom and the vegetable kingdom were not sharply distinguished in the days when science was young, some two or three centuries ago, when even learned men believed in the Scythian lamb,[2] that grew on the top of a small tree-trunk in place of foliage, and in the wonderful tree of the British Isles,[3] whose fruit turned to birds when it fell on the ground, and to fishes when it fell into water; and the two kingdoms are not sharply distinguished to-day, when learned men do not agree upon the systematic position of the Myxogastres and other low forms, some going so far as to assert that many of the simple organisms are on neutral ground, belonging no more to one than to the other kingdom. Dr. Asa Gray[4] once said that "no absolute distinction whatever is now known between them. It is quite possible that the same organism

[1] Read before joint session of Sections F and G of the A. A. A. S., Springfield meeting, Sept. 2, 1895.

[2] Duret, Histoire admirable des plantes, 1605; Jonston, Dendrographias sive historiæ naturalis de arboribus, 1662; LaCroix, Connubia florum, ed. 2, 1791.

[3] Duret, l. c.; Gerarde, Herball, 1597.

[4] Atlantic Monthly, 1860; Darwiniana, p. 124.

may be both vegetable and animal, or may be first the one and then the other."

So numerous have been the vain attempts to find some character of universal diagnostic value that it seems rash indeed to make another trial. But, in case of failure, no harm will be done, even if no advance has been made.

In all attempts, so far as they have come to my notice, the characters selected to distinguish the two kingdoms have been physiological, and not structural. Yet, in the classification of plants among themselves, or of animals among themselves, the characters of acknowledged value are drawn from structure, and physiological distinctions are only considered when the organisms are very minute or simple, like the bacteria and yeasts, or for some other exceptional reason. It seems, therefore, highly illogical to accept a purely physiological character as fundamental for separating the two kingdoms.

On this ground we would discard Linnæus' classification:[5] Lapides crescunt, vegetabilia crescunt et vivunt, animalia crescunt, vivunt et sentient; and that of Hæckel[6] who accords the chlorophyll function to plants and not to animals; and that of Sedgwick and Wilson[7] who find the sole characteristic of animals to be dependence upon proteid food; and also that of Dangeard[8] and Minot,[9] who distinguish the two kingdoms by the manner in which the food, or food material, is taken into the organism. There are also characters, for which I need cite no authority, that were advocated at different times in the past, which have since been discarded for lack of universality, such as a carbon dioxide respiration in plants and an oxygen respiration in animals, that plants exclusively convert inorganic matter into organic matter, that plants alone produce chlorophyll, or cellulose, or starch, etc.

[5] Philosophia botanica. ed. 4, 1809, p 1.

[6] Systematische Phyl genie der Protisten und Pflanzen, 1894; abs. in Science, i, 1895, p 272.

[7] Biology, 1886, p. 167.

[8] Ann. des sci. nat., 7th ser., Bot. T. V.; Comp. rend., 1887; Le Botaniste, 1895, p. 188.

[9] Science, i, 1895, p. 311.

In attempting to distinguish animals and plants by means of definite characters, there is another point that needs attention. Primary characters are to be drawn from the mature condition of the organism, and not from the reproductive or the immature state. This is such an obvious proposition in the ordinary classification of animals or plants, that it seems strange that in diagnosing the two kingdoms it should have been entirely overlooked. There are remarkable similarities in methods of reproduction among plants and animals, not only in the processes, but in the external means for protection and in the methods of dissemination of the reproductive bodies. Especially is this true of non-sexual reproduction among the lower orders. The reproductive structures are sometimes very elaborate, and the organism in that state often attracts more attention than in the vegetative condition, as in the case of the Myxogastres. It is obvious that the individual is the object that we are studying and classifying, and therefore the most fundamental of characters should apply to the individual—the vegetative organism, and not to the mode by which a succession of individuals is maintained.

The following definition of plants and animals is suggested as meeting the requirements of the conditions of classification mentioned above:

PLANTS are organisms possessing (in their vegetative state) a cellulose investment.

ANIMALS are organisms possessing (in their vegetative state) a proteid investment, either potential or actual.

The organism may be a cellular body with the investment extending to each protoplasmic unit, as is usual in plants, or it may be a cœnocytic body with the investment extending only to the compound units, as in most animals and in some plants (*e. g.*, *Mucorinæ*, *Siphonaceæ*). As a rule, the investment is most prominently developed upon the general outer surface of the organism.

By designating the constitution of the walls, it is intended to cover only the original or basic substance of which they are composed, and has no reference to subsequent depositions or infiltrations, of whatever character they may be. Thus in the

walls of grasses and Equiseti there is often a great amount of silica, in certain seaweeds (*Corallina*) much lime, in tunicates so much cellulose that it sometimes amounts to one-fourth of the dry weight,[10] and yet, in the case of the plants named, the original and fundamental substance of the wall is cellulose, and in the animals proteid. A small amount of nitrogen has recently been found by Winterstein[11] associated with the cellulose of fungi, but in what form has not yet been determined. Other instances of a similar nature might be cited.

It may be well to say that by cellulose is meant both primary and compound celluloses and their various modifications, all of which are carbohydrates, and by proteid is meant the nitrogenous, non-protoplasmic substance of walls, no formula for which is known, but which Cross and Bevan[12] suggest "may prove to be of similar carbon configuration to that of cellulose."

There are some organisms which, in their vegetative state, consist of so-called naked protoplasm, of which the most conspicuous and well-known examples are the Myxogastres. Many species of these fungus-animals (Pilzthiere), however, are known to possess a distinct proteid envelop about the plasmodium[13] which, by its chemical reaction, is shown to be non-protoplasmic, and it may be inferred that careful examination will find it present in most of the species, and that it can be considered as potential or undeveloped in the others. They are, therefore, distinctly animal in their fundamental characteristic. Although usually treated in botanical text-books and studied by botanists, they were long since shown by DeBary[14] to have more points of agreement with animals than with plants, and he believed them to be "outside the limits of the vegetable kingdom." This separation by DeBary was made

[10] Schmidt, Zur vergleichenden Physiologie der wirbellosen Thiere. Ann. d. Chem., liv, 1845, p. 318; Schacht, Müller's Archiv, 1851, p. 185; Schäfer, Ueber Thiercellulose, Ann. d. Chem., clx, 1871, p. 312.

[11] Ber. d. d. chem. Ges., xxviii, (1895) p. 167.

[12] Cellulose, 1895, p. 88.

[13] DeBary, Morphology and biology of the fungi, mycetozoa and bacteria, p. 426.

[14] Die Mycetozoen, ed. 2, Leipzig, 1864; l. c., p. 444.

without any reference to a proteid membrane, which may, however, be considered the crucial diagnostic character.

Another set of organisms, with apparently naked protoplasm during the vegetative stage, are the endophytic parasites belonging to the group of genera represented by Synchytrium, Woronina, Olpidiopsis, Rozella and Reesia. Whether they ever possess any demonstrable proteid envelop has not been ascertained, but it is known that they have no cellulose envelop; they are, therefore, not plants, and must, in consequence, be animals. This disposition of them has already been made by Zopf[15] on the ground that a "plasmodial character of the vegetative condition is entirely foreign to the Eumycetes." The Chytridiaceæ, which are usually associated with the Synchytria, have a much reduced but demonstrable mycelium formed of cellulose, and are, therefore, unmistakable plants.

Among the lowest forms, as generally classified, the Rhizopods, including Amoeba, and the far simpler Monera, show no distinct proteid envelop, but neither do they show any indication of a cellulose envelop, and as the other affinities appear to be with animals rather than with plants, they are doubtless rightly placed in the animal kingdom. It is reasonable to expect that more careful examination will, in some cases, show a simple or imperfectly formed proteid envelop.

It may be well to specifically state for sake of clearness that the nature of the investment of spores or sporophores has no significance in this connection. They are to be regarded as adaptations without primary classificatory value.

The crucial diagnostic character, which is here proposed, has in its favor the separation of plants and animals upon a line which accords well with the consensus of opinion of thoughtful students, both botanists and zoologists, an opinion which has been formed from a variety of structural, physiological and developmental data. True relationship must necessarily be adduced from a study of the full life-history of organisms, diagnostic characters only forming points of departure.

[15] Die Pilze, 1890, p. 2.

NOTES ON THE REPRODUCTION OF PLUMULARIAN HYDROIDS.

By C. C. Nutting.

During the past spring and summer, while studying the *Plumulariidæ* at Plymouth, England and Naples, Italy, the writer came across certain facts which are deemed to be of such general biological importance as to render an immediate announcement desirable, without waiting for the completion of a work in which a more formal discussion of these facts and their significance will appear.

Asexual reproduction of Plumularia pinnata Linn.

This species is the most abundant plumularian at Plymouth affording ample material for satisfactory study. The first specimens with young gonangia were brought to the laboratory on May 2nd. Ten days before this I noticed that several fresh specimens were peculiar in having a number of the hydrocladia greatly produced into thread-like extensions ending in a clavate enlargement. Neither hydranths nor nematophores grew upon these processes, although the usual number were found in their normal position on the unmodified portions of the hydrocladia.

These specimens were kept alive in a separate jar, and three days later it was found that the curiously lengthened hydrocladia had continued their abnormal growth, and that some of the enlarged ends had become forked. A microscopic examination showed that the hydrocladial extensions were almost or entirely destitute of nodes, the whole structure being a simple tube, with perisarc, ectoderm and endoderm enclosing the axial cavity in which the life currents were moving in unusual activity. The most notable histological feature was the surprising number of nematocysts embedded in the cœnosarc. The colony seemed in good condition, the hydranths being fully expanded and active.

Under date of April 27th, four days later, I find the following note:

"To-day I noticed some delicate, thread-like lines adhering to the inside of a jar containing living colonies of *P. pinnata*. Upon moving a piece of stone, I found that these lines were the long, thread-like processes or continuations of hydrocladia noticed several days ago. Upon close investigation hydranths were seen fully expanded arising from these processes attached to the glass, and one small colony with the primate branching of *Plumularia* had advanced so far as to show seven hydranths on branches. The original process from the hydrocladium of the parent colony has become a creeping stolon attached to the glass. It is sending up the new colony on the one hand, and giving forth delicate rootlets on the other. A single hydranth growing on the stolon a little to the right of the incipient colony already described, seems to indicate the starting of a second colony. Several other stolons (derived in the same way from greatly elongated hydrocladia) are giving off little colonies. There have been no other plumularians in this jar, and the original colonies were without gonangia."

These new colonies were kept alive for a week longer, by which time their connection with the parent stocks had been destroyed by atrophy of the hydrocladial extensions from which the new colonies arose, and the daughter colonies had attained considerable size and all the characteristic features of *P. pinnata*.

In another jar a colony showing the hydrocladial extensions was purposely placed so that they could reach neither the side of the jar nor any other point of support. This did not interfere with the asexual reproduction, however, as the processes became forked at their distal ends, and from these forks arose incipient colonies. After a week had elapsed the parent colony died and the main stem became withered and dropped to the bottom of the jar, carrying with it the daughter colonies which were then able to attach themselves and proceed with their development as would any other colony.

After a careful search through the literature of the subject, I am unable to find any account of this mode of re-

production either among hydroids or any other of the metazoa, and I propose for it the name *Stoloniferous reproduction* on account of the great similarity which it bears to that process among plants.[1]

Asexual multiplication has long been known to exist among the hydroids, where it usually presents itself in some form of gemmation. Fission has been found to occur in a medusa, *Stomobrachium mirabile* Köll., but the most remarkable case heretofore recorded is described by Allman in a campanularian named by him *Schizocladium ramosum*.[2] The process is, in brief, as follows:

An ordinary ramulus, instead of bearing a hydranth on its distal end, elongates and the cœnosarc ruptures the chitinous investment at the tip and protrudes naked into the water. A constriction takes place by which this naked cœnosarc is divided off and finally separated from the parent stem. "The detached segment is now the $\frac{1}{150}$ of an inch in length, and strikingly resembles a planula in all points except in the total absence of vibratile cilia. It attaches itself by a mucous excretion from its surface to the walls of the vessel, and exhibits slight and very sluggish changes of form. After a time a bud springs from its side, and it is from this bud alone that the first hydranth of the new colony is developed."

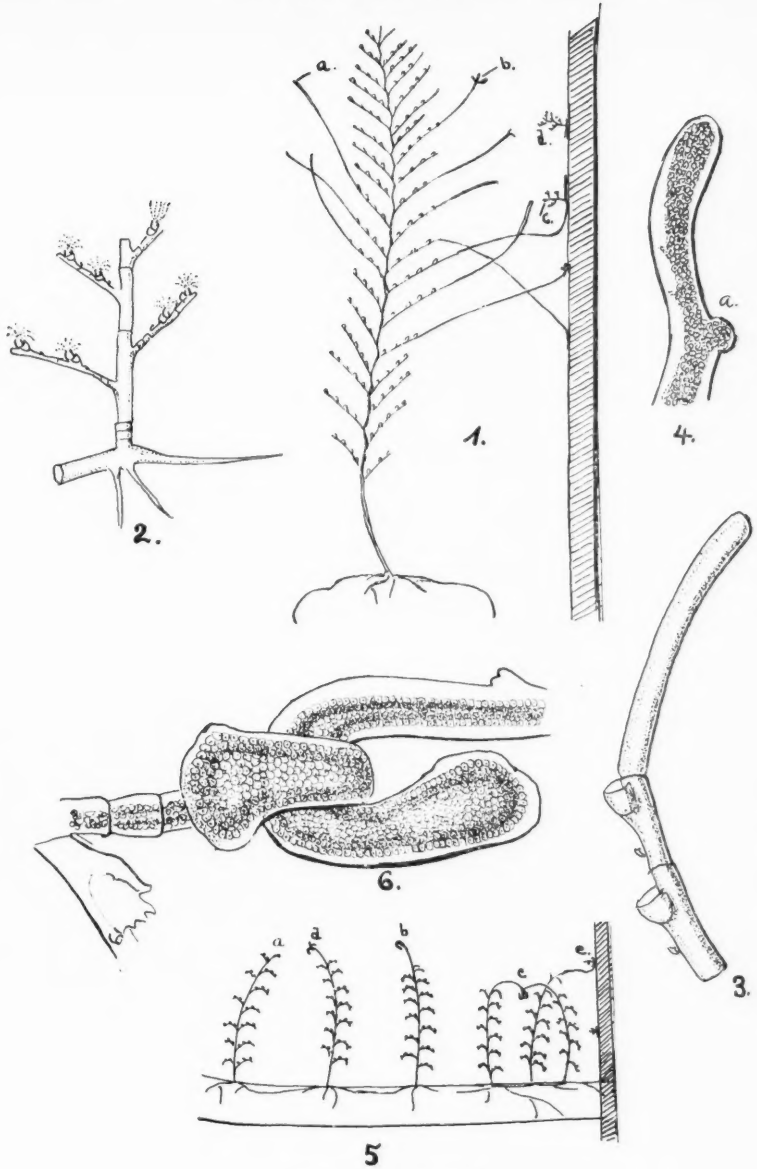
Although this process resembles the stoloniferous multiplication of *Plumularia pinnata* in the formation of a new colony from a modified branch termination, it differs greatly in the fact that in *Schizocladium* the divided portion or "frustule," as Allman calls it, becomes entirely separated from the parent stock before the new colony begins to develop, while in *P. pinnata* there is a vital connection by means of the greatly elongated hydrocladium.

The stoloniferous multiplication must not be confounded with any of the many modes of branching heretofore found among the hydroids, which do not give rise to separate colo-

[1] "Stolons are trailing or reclining branches above ground which strike root where they touch the soil, and then send up a vigorous shoot which has roots of its own, and becomes an independent plant when the connecting part dies, as it does after awhile." Gray, School and Handbook of Botany, p. 37.

[2] Report Brit. Association, 1870, and "Gymnoblastic Hydroids," p. 151, 152.

PLATE XXXII.



Plumularia pinnata L.

nies having independent hydrorhizæ; neither is it equivalent to the multiplication often effected by mutilation. There is no mutilation in this case, unless we may so regard the spontaneous atrophy of the connection between the old and new colonies.

That this stoloniferous multiplication is normal is indicated by the fact that specimens fresh from the sea exhibited the greatly elongated and forked hydrocladia.

It may be well to note that *P. pinnata* seems to have reproductive powers greater than those of any other Plumularian known to me. At the proper season that part of the stem from which the hydrocladia spring is fairly packed with gonangia which may even be crowded out onto the hydrocladia. In some instances it seemed as if the reproductive potentiality demanded some other outlet, and long processes, exactly like the hydrocladial processes described above, were seen springing from the interior of the gonangia themselves.

The possibility of conjugation among the Plumularidae.

During the months of June, July and August a small species of *Aglaophenia* was brought almost daily to the Naples Zoological Station. It grows on a long ribbon-like alga in shallow water and bears a general resemblance to *A. pluma* Linn., from which it differs in exhibiting a frequent intercalation of intervening internodes on the distal half of the stem, in the more distant hydrocladia, and in having, as a rule, not more than three hydrothecæ to each internode.

In June it was noticed that a large proportion of the colonies had the end of the main stem greatly elongated and enlarged, the proximal part of this extension being divided into a great number of short internodes, while the distal portion was abruptly bent over so as to form a nearly closed hook. In many cases the ends of two colonies would be hooked together, clasping each other so tightly that they could not be separated without mutilating the specimens. This state of affairs was so common at this time that one could not regard the attachment as accidental or abnormal, and further developments were awaited with great interest.

In July this attachment was seldom seen, although the enlarged stem terminations were still common. These latter appeared to be shedding their perisarc, which was often seen to be partly peeled off.

About the middle of August I observed that these enlarged ends were *forking* just as did the produced hydrocladia of *P. pinnata.* Still later, immediately before my departure from Naples, I found some of these enlarged ends attached to the sides of the jar and budding, although the buds had not yet developed into hydranths. There is practically no doubt that we have here a case of stoloniferous reproduction in the genus *Aglaopheñia.*

Although I was unable to demonstrate the use of the clasping hooks at the ends of the stems, it was impossible to escape the constantly recurring suggestion that they might possibly signify a mode of *conjugation* such as is found among the Protozoa (e. g., *Paramecium*) and the Algæ (e. g., *Spirogyra*).

That these hooked ends are for some definite purpose can be confidently assumed, and there are but two explanations which appear plausible.

1st. These terminal hooks may aid directly in the stoloniferous reproduction by attaching themselves to some adjacent object upon which the new colonies can grow.

2nd. They may be clasping organs for use in conjugation. As a matter of fact they may serve both purposes. My observations strongly indicate that they are useful as a means of attachment, and the following considerations indicate a strong possibility that conjugation may take place.

1st. They were seen so often in a position favoring conjugation, i. e., with the ends of two colonies clasped in a close embrace as to indicate a normal function.

2nd. It was after this supposed conjugation that the stoloniferous multiplication was observed to be under way.

3rd. These enlarged ends of the stems were found to contain a number of amæboid cells which were unusually active, sending out pronounced pseudopodia. I could not decide definitely whether these cells were in the ectoderm or endoderm, on account of the unfavorable position of the living colony under inspection.

Stained sections of these hooks failed to throw much additional light on the subject, the only noticeable histological feature being an appearance of great activity in cell multiplication, and the presence of an unusual number of nematocysts. These sections were of value, however, in demonstrating that the enlargement of the stem termination was *not* due to the presence of a parasite, as is sometimes the case among hydroids, e. g., *Syncoryne eximia* and *Coryne mirabilis.*

The clasping of the hooks is probably effected mechanically by the undulations of the ripples passing along the alga which supports the hydroid colonies.

Conjugation is essentially the union of two individuals of a species during which an interchange of protoplasm is effected without the intervention of ova or spermatozoa. So far as I have been able to discover this process has not heretofore been found among the metazoa,[3] and the observations recorded above must be regarded as merely an indication of the possibility of conjugation among hydroids.

It is now a well established fact that the sex cells, both male and female, of the Plumulariidæ originate in the endoderm of the stem; and any process which would enable the contents of the endodermal cells of one stem to mix with the contents of the endodermal cells of the stem of another colony would render conjugation possible so far as the purely mechanical part of the question is concerned. This would be effected in the case under consideration by the solution of the contiguous walls of the hooks when clasped as already described. While this solution was not actually seen in any of the specimens described by me, it was found that the perisarc was usually thinner in the region of contact than elsewhere.

It must be remembered, moreover, that in the normal reproduction of most hydroids a solution of the perisarc of the stem is effected, probably by chemical action, whenever a gonangium is formed,[4] and therefore no new principle would have to

[3] The permanent union of individuals which results in *Diplozoon* cannot be termed conjugation in the sense here used, because in the Diplozoon the intervention of ova and spermatozoa occurs.

[4] "Die Entstehung der Sexualzellen bei den Hydromedusen." Dr. August Weismann, p. 182.

be invoked to accomplish this end in the case under discussion.

In passing from below upward in the stem of a plumularian examined just before the appearance of the gonangia, we find that the sex cells intergrade perfectly with the ordinary endodermal cells, many of which are themselves destined to become sex cells. The endodermal cells, then, in the distal part of the stem, contain that which will ultimately become ova or spermatozoa, or they contain what might be called the undifferentiated sex elements. A given colony of Aglaophenia is always unisexual. That is, all the gonangia contain sex cells of one kind, and both ova and spermatozoa are never found in one colony.

Now it is evident that the hooking together of a male and a female colony by the upper parts of their stems, accompanied by a dissolving of those portions of the perisarc which are in contact, would leave only the thin ectoderm between the endodermal cells of the two colonies, and a communication between the undifferentiated sex cells would be an easy matter; for Weismann found that the undifferentiated sex cells exhibited pronounced amœboid movements[5] and such movements would, of course, greatly facilitate conjugation. The amœboid cells observed by me in the clasping hooks may be of significance in this connection. Not only did these cells exhibit activity in sending forth pseudopodia, but they also moved bodily from place to place among the surrounding cells.

State University of Iowa, Sept. 26, 1895.

Explanation of Plate.

1. Colony of *Plumularia pinnata* Linn. showing (a) hydrocladial extensions; (b) forking of ends of hydrocladia; (c) new colony still attached to parent stock; (d) new colony separated from parent stock.
2. New colony, magnified, showing polyps and rootlets.
3. Portion of hydrocladium showing terminal extension.
4. Tip of hydrocladial extension showing (a) the budding of a new colony.

[5] This fact was repeatedly observed by the present writer.

5. Colonies of *Aglaophenia* sp. showing (a) terminal extension of stem; (b) terminal hook; (c) clasping of hooks; (d) budding of hooks; (e) new colony attached to side of jar and to parent stock.
6. Clasping hooks, magnified.

ANTIDROMY IN PLANTS.

By G. Macloskie.

In November, 1893, I published observations on Maize, from which it appeared that there are two castes of this plant, the leaves of one reversing the arrangement of those of the other. I also traced this diversity to the arrangement of the minute leaves in the young embryo in the seed; thus in figures 1, 2, the first foliage-leaf has its right margin overlapping its left margin. In other seeds from the same ear the first leaf would have its left margin external. I further found that the grains arising on adjoining rows in the ear of corn are of different castes, and produce "antidromic" plants (that is, growing up in opposing curves), and that the same property belongs to all the Gramineæ.

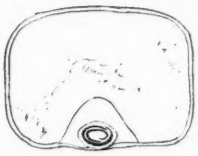


Fig. 1.
Grain of Maize; cross section.

Fig. 2.
Young leaves of Plumule of Maize.

During the past summer I have extended this law so as to embrace the flowering plants. Every species is represented by two sets, differing antidromically as to the structure of the mother-seed, the stem, leaves and inflorescence. My attention was first attracted to this in the Ladies' Tresses (*Spiranthes præcox* Watson), which had, in some plants, dextral, in others sinistral, rows of white flowers; and on examination the dextral and sinistral anthotaxy were found to be accompanied respectively by dextral and sinistral phyllotaxy. Fig. 3,

representing *Spiranthes aestivalis* Rich., shows, in a less crowded manner the sinistral anthotaxy[1] This specimen would doubtless have sinistrorse phyllotaxy, and there should be other specimens with dextrorse tresses and leaf spirals. Thus it appears that the much-belabored phyllotaxy of the old botanists is a special case of a larger subject. The homodromy of phyllotaxy and anthotaxy within a single individual may be observed in *Ænothera biennis, Verbascum thapsus, Laportea* and *Pontederia;* and even in *Gladiolus* and *Iris* we may trace a correspondence between the order of equitant leaves and the inflorescence. Whilst the produce of propagation by cuttings, buds, and bulbs is always homodromic with the parent stalk, some forms, like Calla-lily, Iris and Rush, when growing from division of a root-stalk, appear to be antidromic as if produced from different seeds. Fig. 4 shows the spathes of two Calla-lilies, from the same root-stalk, *d* having the dextral margin overlapping, and *s* having the sinistral overlapping. We may add that the akenes on the spadix of *d* make a dextrorse spiral, and those on that of *s* make a sinistrose spiral.

Fig. 3. *Spiranthes aestivalis* Rich., after Engler and Prantl.

In this connection it is interesting to observe that (so far as I am able to determine from leaves of *Bryophyllum* supplied me by Amherst Agricultural Station) the buds growing on opposite margins of the leaves are relatively antidromic.

Secondary changes, due to twining of stems, spreading out of leaves under the light, opposition of leaves, and crowding of flowers, and perfect symmetry of seeds, often disguise the primitive character, especially in the Dicotyledones. But, even in these cases, we commonly find some trace remaining. In the great majority of plants, in fruit trees, garden flowers and weeds, the phyllotaxy immediately divides the representatives

[1] Dextral and sinistral in this connection signify in the direction, or against the direction, of the thread of a common screw.

of every species into a right-handed and a left-handed caste; and even when sunlight interferes, we often get help from

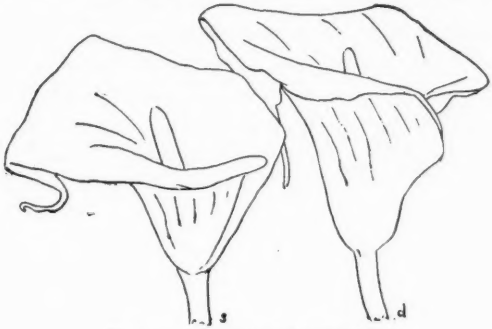


Fig. 4.—*Richardia africana* Kunth.

branches in the shade. Examples of it abound in all the more important orders of plants, and there seems to be no exception, though in opposite-leaved forms the evidence from phyllotaxy is not easily available. I have found no case of heterodromy as between the true foliage leaves of an individual plant; and the only case in which I have failed to observe antidromy between different plants is the Canna, which is mostly propagated by bulbs. (Doubtless there are specimens with a right-handed twist of the young leaves, though I have failed to find any.) In a bed of *Lily of the Valley*, half of the specimens have the inner leaf diverging 120° to the right, and the rest have similar divergency to the left. (Fig. 5.) In this, as in other Liliaceæ, the anthotaxy will be found to vary in harmony with the phyllotaxy.

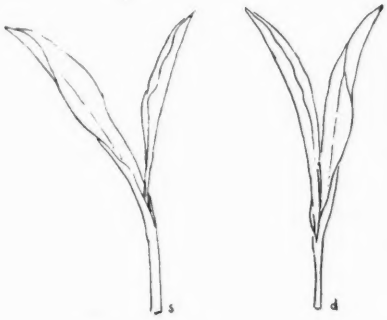


Fig. 5.

Doubtless the antidromic phyllotaxy causes a corresponding antidromy of the leaf-traces, and of structure of the stem. This has escaped anatomists who expected symmetry; but some of the figures in the books show a trending of leaf-

traces to one side, and in all such cases we may be certain that some of the individuals have similar trending to the opposite side.

The structure of the embryo, and of the seed as conforming to the embryo, is very closely identical with that of the adult plant, and is of use to us when the other evidence is hidden. Thus fig. 6 shows the flat surface of a coffea-akene; half of the akenes are of this pattern, the other half resemble the image of this in a mirror. Fig. 7 shows a cross-section (*r*) of fig. 6;

Fig. 6.

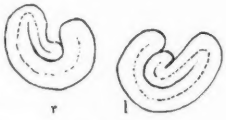


Fig. 7.

Fig. 8.

and also (*l*) of the antidrom of fig. 6, under the same orientation, and thus revealing the reverse order of the infolding of the endosperm. Fig. 8 presents the seed and embryo of *Nelumbium;* on seeing this I predicted the existence of other seeds with the embryo facing the opposite way, and promptly Mr. Barney and myself fished out of the Lily-ponds of Springfield, Mass., plenty of seeds which showed, under similar orientation, the embryos facing some one way and some the opposite way. The petals of Water-lilies are also diversely enfolded in the bud of different plants. The seeds of Lima-bean were found to have characteristic differences in the mode of enfolding upon each other of the first two foliage-leaves; and all the seeds growing on one valve of the pod were of one character, whilst those growing on the other valve were the antidroms of the former. The germinating pea sends up its plumule with a slight twist to one side or the other. The embryo of Basswood, with its large 5-lobed cotyledons, shows antidromic twists as between different seeds; and diversity is seen in the

mode of folding of the embryos of the two seeds, produced by one flower, of Maple (*A. platanoides* L.). In Horse-chestnut the radicles of different seed incurve antidromically (*a* and *c* of fig. 9), and the young leaves of the plumule (situated inside the radicle at *p* of fig. *a*, enlarged at fig. *b*) show the leaflets differently arranged at the two sides, indicating the same primitive torsion as in other plants. The torsion of the plumule of *c* would be antidromic as compared with that figured.

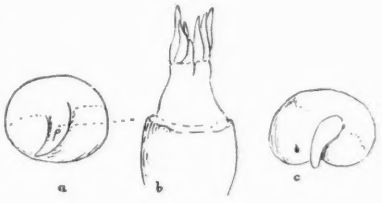


Fig. 9.
Embryo and Plumule of Horse-chestnut.

That the place of origin of the seeds is ordinarily the determining cause of this character is proved by Corn, Coffee, Bean, Lepidium, and other seeds. In Gymnosperm the bilateral origin of the seeds, and the spiral arrangement of their numerous cotyledons point to the same inference, which is confirmed by the phyllotaxy, and by the primary spirals formed by the scales of their cones, as well as by the lateral bending of their woody tissues. We may ascribe to this cause the habit of splitting of tree-trunks in contrary spirals, and I think that the same tendency sometimes shows itself in the sculpturing of the cortex, so that from the bark of Chestnut and hard-barked Hickory I can infer the direction of the phyllotaxy without seeing the leaves.

Direct evidence as to the Convulvulaceæ is difficult because of secondary distortions. But indirect evidence is available. Morning-glory has an incumbent curvature of the embryo as in many Cruciferæ, indicating such a diversity between the two seeds in a locule as produces in Cruciferæ antidromic phyllotaxy. This may also help to explain the twist of the embryo of *Lepidium virginicum* L. which has puzzled botanists, and if our surmise is good, we may expect to find the embryos of two seeds of the same fruit antidromically twisted.

After writing as above I examined the seeds from the two carpels of a flower of *L. virginicum*, and found them anti-

dromic. The same explanation applies to the embryo of *sisymbrium officinale*, and to the spirally-folded embryos of *Chenopodiaceæ*. The two forms of the embryo of *Salsola kali* are figured in Engler and Prantl's Pflanzenfamilien (III, 1a, p. 84, Y, Z). The pods of mesquit (*Prosopis*) and of *Impatiens* have a right or left twist in harmony with the antidromic phyllotaxy of the plant on which they grow.

These observations help to solve old problems, recall phyllotaxy to the science in an improved garb, open up new lines of research, and start curious problems about heredity. If, however, the ovum is able to transmit the secondary characters of a species, there will be small difficulty found in admitting that it can transmit the primitive characteristics that are common to all Phanerogams, and that possibly belong also to the higher Cryptogams. But the curious point is the difference of heredity as between the two sides of a carpellary leaf; and other problems are started by such cases as Richardia. I wish to explain that my work has been necessarily done in haste, and whilst, as a whole, I think it is sound, it will doubtless need rectification in details.

Postscript.—In the above I have unfortunately overlooked the valuable observations of Prof. W. J. Beal on *Phyllotaxis of Cones*, published in the American Naturalist of August, 1873 and March, 1877. He found the cones of individual spruce and larch trees to be heterodromic. If this should prove to be general or frequent, it may possibly be accounted for by secondary torsions during growth. My own observations on *Tsuga*, *Pinus*, etc., favor the view given above; and I may add that the arrangement of florets in heads of sunflowers and other compositæ appears to be antidromic and in accord with the phyllotaxy of the respective plants.

The cones of coniferæ change in opening so as to make the secondary spiral appear the dominant one. I have a cone of *Picca excelsa*, with ten scales open on one side, where they appear dextrally arranged, whereas the unopened side shows the primary arrangement to be sinistral. Taking the opened and unopened cones of the whole tree, one might conclude that half the cones were antidromic to the others.—G. M.

THE FIRST FAUNA OF THE EARTH.

By Joseph F. James.

(*Continued from page 887*).

In 1886, there came an announcement from Sweden that was received with incredulity upon this side of the Atlantic. The geologists there had determined that instead of the *Olenellus* fauna occupying the middle position, it was at the base, and the *Paradoxides* fauna was in the middle. Continuous sections showed the rocks of Lower, Middle and Upper Cambrian age in conformable succession, and the question at once arose, Could there be one sequence upon the eastern and a different one on the western side of the Atlantic? If not, then which was correct? The difficulty on this side was to find a continuous section, and it was not until 1888 that it was found. In that year, Mr. C. D. Walcott, now the Director of the U. S. Geological Survey, found in Newfoundland the desired section. Here the *Olenellus* fauna was at the base, and the *Paradoxides* fauna was above it.

The base of the Cambrian being thus at last defined, it then remained to ascertain the extent and variety of organic life in these old rocks. To Mr. Walcott again the world owes the best exposition of this fauna. In a paper published in 1890, he showed there was a variety and profusion of life that had never before been imagined. In this fauna there were representatives of all the great classes of invertebrates. Strange to say, the most highly organized class had the greatest number of species, as shown below:

Spongiæ	4 species.
Hydrozoa	2 species.
Actinozoa	9 species.
Echinodermata	1 species.
Annelida (?)	6 species.
Brachiopoda	29 species.
Lamellibranchiata	3 species.

Gastropoda	13 species.
Pteropoda	15 species.
Crustacea	8 species.
Trilobita	51 species.

The astonishing number of 141 American species was therefore known in 1890 from this very old series of rocks, and this has since been added to until there are now known from the world nearly 200 species, distributed among about 75 genera. The illustrations accompanying this article show some members of most of the classes above-mentioned. In Figure 4 is shown the cup of a small specimen of *Archæocyathus profundus*, one of the Actinozoa. In Figure 5 we have two views of *Medusites lindstromii*, one of the Hydrozoa, and supposed to represent casts of the gastric cavity of a jelly-fish. In Figure 6 there are shown a number of forms of Brachiopoda, a class which, in times past, was very abundant, but which now has only a limited number of representatives. Figure 7 shows some species of

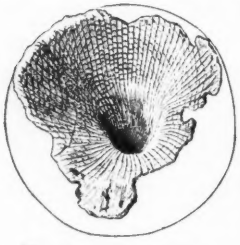


Fig. 4. *Archæocyathus profundus.*

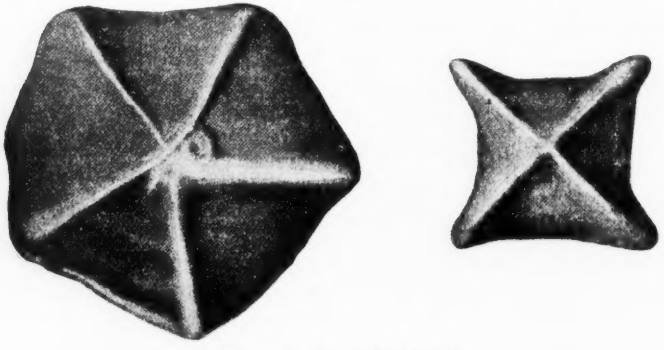


Fig. 5. *Medusites lindstromii.*

Gastropods and Figure 8 the three known species of Lamellibranchiata or bivalve shells which are, to-day, so abundant in the fresh and salt waters of the globe. In Figure 9 there is

shown one of the species of annelids. The soft bodies of these animals have, of course, decayed, and all that remains to tell of their former existence is a vast variety of trails and burrows, which, in some places, cover the rocks in myriads. The problematic character of fossils has caused them to be described as Algæ, but there seems no reason to doubt that they were really worm casts, burrows or trails. In Figure 10 are shown some species of Hyolithes, a genus of *Pteropods* now entirely extinct, but represented in the Lower Cambrian by eight species and one variety. Figure 11 is a representation of a

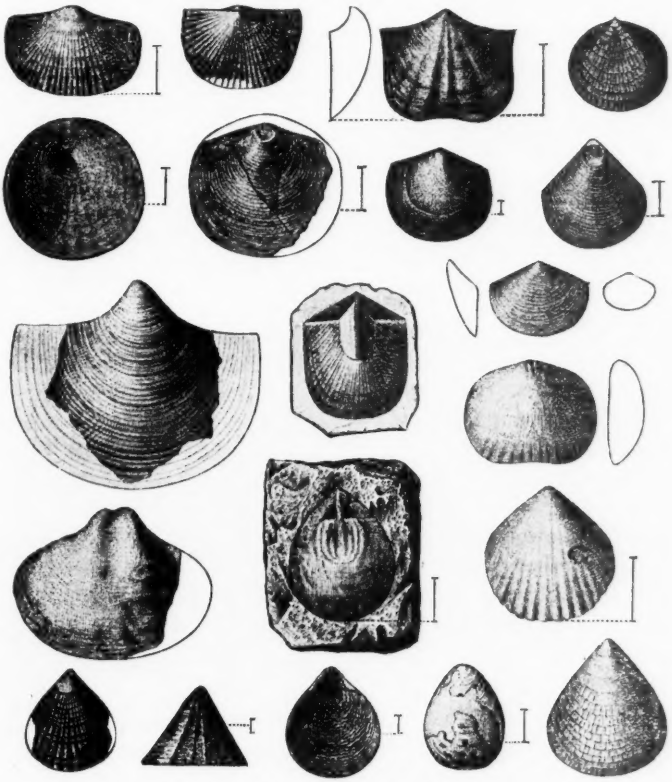


Fig. 6. Various species of Brachiopoda.

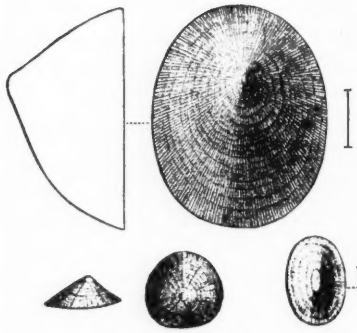


Fig. 7. Gastropoda.

crustacean in a nearly perfect state of preservation, and Figure 12 is a group of trilobites of various genera, most of them belonging to the typical genus of the Lower Cambrian, *Olenellus*. This genus, as pointed out by Walcott, is probably genetically related to *Paradoxides*, the typical genus of trilobites of the Middle Cambrian, and it has its modern, living proto-

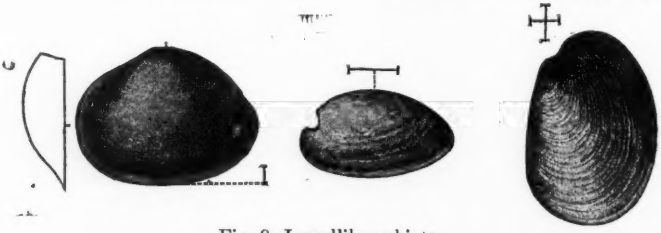


Fig. 8. Lamellibranchiata.

type in the common horseshoe crab, *Limulus*, of the Atlantic coast. It would be an interesting fact, and a not altogether improbable one, to find in *Limulus* a descendant of *Olenellus* of the Lower Cambrian.

Fig. 9. Trails of Annelids (*Planolites*).

Besides the great variety of forms found in this very ancient fauna of the globe, there is the interesting subject of geographical distribution and its connection with the study of evolution. As already stated, the three great divisions of the Cambrian, the Lower,

Middle and Upper, are each characterized by a special genus of trilobite. In the lower zone we have *Olenellus*, in the middle zone *Paradoxides*, and in the upper zone *Dikellocephalus*. These three genera are so closely related that it does not require any stretch of the imagination to regard one as a descendant of the previously existing form. It is true there are no exactly connecting links between the three, and yet there are genera known which have certain intermediate characters. In some localities the three zones present an almost conformable sequence, with scarcely a break in sedimentation, but in other places there is a very perceptible time interval between them. In the former cases, the intermediate genera are known to occur.

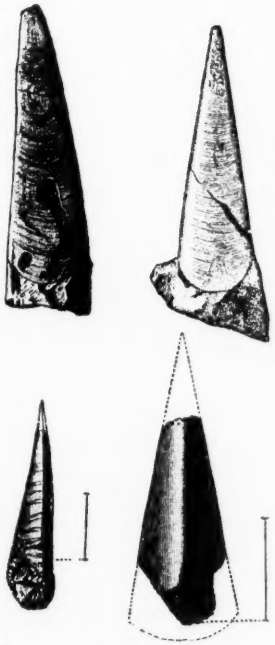


Fig. 10. Pteropoda (*Hyolithes*).

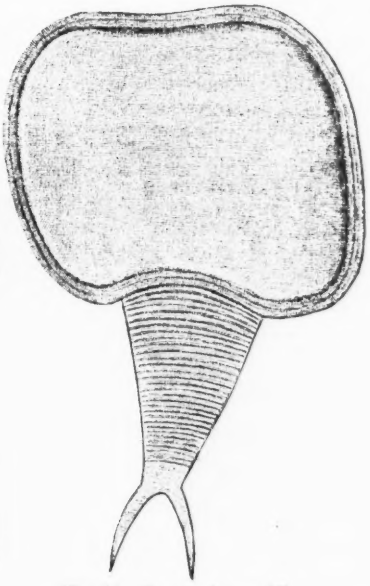


Fig. 11. *Protocaris marshii.*

We have already seen that the fossils of the Lower Cambrian are found in New York, Vermont, New Brunswick, Newfound-

land, Sweden, Wales and Bohemia. But they have likewise been collected in Massachusetts, Georgia, Alabama and Tennessee on the Atlantic side of North America, and from British America, Utah, Nevada and California on the Pacific side. They have also been found in France, in Sardinia, and in Russia, while fossils of the immediately succeeding middle and upper zones occur in all these places and in India, China, Australia and South America. It would thus appear that at a very early period in the history of the earth, the faunas then living had an almost world-wide distribution. There is, however, little to be wondered at in this, since it is probable that the conditions of existence at that early day were very uniform.

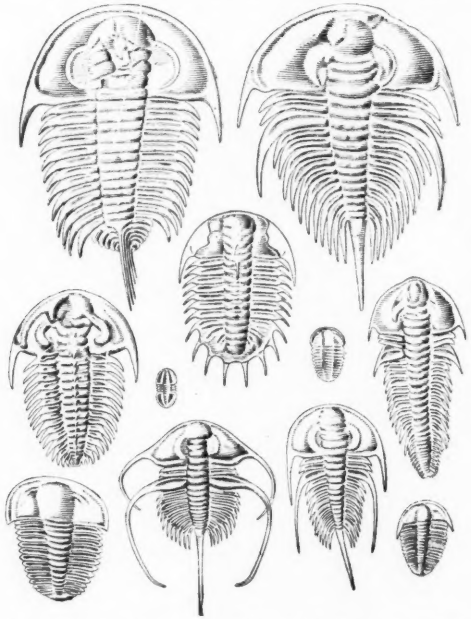


Fig. 12. A group of Lower Cambrian Trilobites (much reduced).

What these conditions were in other countries besides Europe and North America can not be stated, since the rocks in the more remote places have not been studied with the

same care as in America and Europe. From the studies of Mr. C. D. Walcott and others, it seems clear that the continent of North America in Cambrian time had essentially the same outline it now has, although it was considerably less in extent. In brief, it has been ascertained that there was a depression along the margin of what is now the Appalachian chain from Newfoundland to Alabama, protected from the open sea, the primitive Atlantic, by a fringe of islands. Along the western slope of the site of the Rocky Mountain chain the same conditions prevailed, and in these two troughs the fauna lived and flourished. During Middle and Upper Cambrian time, conditions became modified so as to allow the fauna to exist in other localities, notably in Minnesota, Wisconsin and Texas.

Where the faunas originated, and how they spread from place to place, so as to become so widely scattered over the globe, are questions it is not, at present, possible to answer. That we know as much as we do about the life on the earth at so distant a period in its history, is owing to the patient work of a few enthusiastic students, among whom Mr. C. D. Walcott must always occupy a prominent position.

EDITOR'S TABLE.

—THE public is acquainted with the results of Peary's last expedition from which he has just returned. He was not able to discover his principal caches of food, and this, with the treachery of some of his Esquimaux, prevented him from reaching the coast which he discovered on his first expedition. He turned back in time to permit his reaching his camp of departure just as his provisions were exhausted. A heavy storm at the end might have ended his career at no great distance from his base of supplies. This season and the last were unfavorable for arctic exploration, and it is quite possible that some one may yet utilize Peary's supplies and reach higher latitudes in Greenland. It is, however, certain that Greenland does not lie in the most available route to the pole, which is by way of the islands north of Siberia. Science awaits with interest the results of Nansen's bold

enterprise by sea, and of Jackson's Expedition across Franz Joseph land. When once the way is open, science will send its votaries to the field which is awaiting them.

Peary's observations and collections in Ethnology, Meteorology and other departments on Inglefield Gulf will repay the cost of the expedition; and the results of the relief expedition, like those of its predecessors, are of great value. Large collections were made by the latter, which will go to the American Museum of Natural History of New York, and the Museum of the University of Kansas.

—Mr. L. O. Howard, of the Department of Agriculture of Washington, has made a discovery which will probably be of great practical importance. He finds that a thin stratum or film of oil on the surface of the water where they breed, will destroy the larvæ of mosquitoes. This will prove welcome news to people living in many localities. How to destroy this pest of many parts of the earth has been a subject of thought for a long time. The late Dr. Robert Lamborn gave two prizes for essays which advocated the propagation of dragon-flies as the most feasible mode of attack, since the mosquito is the natural food of these raptorial insects; but no one has yet undertaken to demonstrate the practicability of the plan. The application of oil to the waters of swamps and lagoons where the Culices breed, is a simple matter, and the expense will be small in comparison with the advantage gained. The use of oil in the valley of the Missouri River, and on many parts of our coast, would increase the value of the land to an untold degree. In fact, the habitable part of the earth in many latitudes must be greatly increased in extent by this discovery. Meanwhile we must be content to let these small creatures render life miserable or impossible, and hide behind "bars" which do not always protect, or suffocate in stinking smudges, until the use of oil for their destruction becomes general. In waters which are not private property, it will be well for the States to lead the way, and make appropriations for the purpose.

RECENT LITERATURE.

Bulletin of the U. S. Fish Commission for 1893.[1]—The contents of this volume comprise the papers that were read at the congress

[1] Bulletin of the U. S. Fish Commission, Vol. XIII, for 1893. Washington, 1894.

of persons connected with fishery interests, held in Chicago Oct. 16, 1893. The papers cover a wide range of subjects, and being the views of men qualified by experience and study to speak upon the subjects treated, are of practical worth. A synopsis of the topics discussed includes: 1. Fishery laws and administration of the fisheries. 2. The sciences in relation to fisheries and fish-culture. 3. Methods of capture, utilization and distribution of fishery products. 4. Fish-culture. 5. The world's fisheries. In addition, an interesting paper is contributed by G. F. Kunz on pearls, and the utilization and application of the shells in which they are found, in the ornamental arts, as shown at the World's Columbian Exposition. The illustrations of this article are beautiful both in subject and execution.

Geological Survey of Michigan, Vol. V.[2]—The contents of the present volume comprise a report upon the Iron and Copper regions of the Upper Peninsula by Dr. Rominger; and a paper by A. C. Lane, on deep borings in the Lower Peninsula, based on the work done by the late Mr. Wright. Mr. Lane's paper is prefaced by a brief chapter on the origin of salt, gypsum and petroleum written by the State Geologist, Mr. L. L. Hubbard, and is accompanied by 73 plates and a map.

Dr. Rominger's report covers the work done in the iron region in 1881 and 1882 and includes recent observations made in the Copper-bearing or Keweenan group.

Geology of Minnesota.[3]—The materials for this quarto volume have been accumulating since the Survey began, and it has been found desirable to issue the publication in two parts. Pt. 1, includes 5 chapters on the paleontology and systematic geology of the Lower Silurian which is found in the southeastern part of the State, and a historical sketch of investigation of the Lower Silurian in the Upper Mississippi Valley. The paleontological work is distributed as follows: Cretaceous Fossil Plants, Leo Lesquereux; Cretaceous Microscopical Fauna, A. Woodward and B. W. Thomas; Notes on other Cretaceous fossils, N. H. Winchell; Lower Silurian Sponges, Graptolites, Corals and Brachiopods, N. H. Winchell and C. Schuchert; Lower Silurian Bryozoa, E. O. Ulrich. Each chapter is accompanied by page plate illustrations, 34 in all.

[2] Geological Survey of Michigan, Vol. V, 1881–1893. Lansing, 1895.

[3] Final Report of the Geology of Minnesota, Vol. III, Pt. 1, Paleontology. Minneapolis, 1895.

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General Notes.

MINERALOGY.[1]

An Instrument for Preparing Accurately Oriented Sections and Prisms from Crystals.—Mention has been made in these notes of the valuable instruments which Tutton has designed in connection with his recent studies in the field of chemical crystallography. One of them[2] is an instrument of precision for preparing prisms or sections of the delicate crystals of artificially prepared compounds. The methods now in use for making these preparations require a prodigious amount of labor while securing only a rough approximation to the desired orientation. Of his new instrument Tutton says:

"It is possible by the use of the instrument to grind and polish a truly plane surface in any direction in a crystal so as to be true to that direction to within ten minutes of arc, an amount of possible error which would exercise no measurable influence upon the values of the optical constants. Moreover, this result may be achieved in a small fraction of the time hitherto required, and with only the very slightest risk of fracturing the crystal. An arrangement is also provided by which a second surface may be ground parallel with a like degree of accuracy to the first."

This somewhat elaborate piece of apparatus is constructed like an inverted goniometer with horizontal circle, being provided with graduated disc, the usual centering and adjusting device, telescope, collimator and lamp. A revolving table mounted in an excentric position under the crystal and driven by a turning table, carries a ground glass plate for grinding and a finer one for polishing. The pressure of the crystal on the glass is delicately regulated by means of counterpoised levers which support any desired portion of the weight of the instrument's axis, the remaining portion bearing directly on the crystal.

A larger, stronger, and somewhat modified form of this apparatus[3] has been designed for carrying out the same operations on the hard natural crystals. This form is provided with a cutting apparatus, which, when not in use, is rotated out of the way so as not to interfere

[1] Edited by Dr. Wm. H. Hobbs, University of Wisconsin, Madison, Wis.

[2] Philosophical Transactions, Vol. 185, (1894), A, pp. 887–912.

[3] Tutton, Proc. Roy. Soc., Vol. 57, pp. 324–330.

with adjusting the crystal or grinding. The grinding table is supplied with nine different laps suited to minerals of different degrees of hardness and to artificial crystals. The apparatus may be driven by a small motor, the current from three pint bichromate cells being ample. These instruments are constructed by Messrs. Troughton and Simms, the smaller instrument at a cost of £40, and the larger one, which is adapted for use of mineralogists and chemical crystallographers alike, at a cost of £60.

An Instrument for Producing Monochromatic Light of any Wave Length.—The same author has constructed an instrument to furnish strong light of any desired wave length, which wave length may be changed at will.[4] The source of light is an oxy-coal gas lime lantern and the dispersive apparatus a specially constructed spectroscope in which the telescope is replaced by a collimator tube and slit exactly like the one on the side of the instrument toward the source of light. The prism has a refracting angle of 60°, is prepared from heavy flint glass, and is rotated on a graduated circle so as to allow any desired wave length of the spectrum to pass through the exit slit. This is diffused by a plate of ground glass before it enters the goniometer, total refractometer, or axial angle apparatus, in which it is utilized in determining the index of refraction or the size of the optical angle. It is thus possible to extend indefinitely the measurements to show the amount and character of the dispersion of crystals, while greatly facilitating the measurements themselves. By replacing the exit slit by diaphragms having two or more slits at proper distances apart, composite light made up of any desired wave lengths may be employed, which is very useful in studying crystals with crossed axial planes like brookite.

Other Mineralogical Apparatus.—Wolff[5] gives detailed instructions for making diamond saws suitable for section cutting, also directions for sawing sections so thin that only a small amount of subsequent grinding is necessary.—Federow[6] describes the simplest form of his universal microscope stage, which is specially adapted for rapid petrographical determinations. At the same time he advocates lengthening the heretofore circular opening in his ebonite section holder.

[4] Philosophical Transactions, Vol. 185, (1894), A, pp. 913–941.

[5] Am. Journ. Sci., XLVII, pp. 355–358, (1894).

[6] Zeitsch. f. Kryst., XXIV, p. 602.

Determination of Optical Sign in Random Mineral Sections.—Using the universal microscope stage Federow[7] shows that it is possible and usually quite easy to determine the optical character of a mineral from random sections. In the case of uniaxial minerals the section is revolved between crossed nicols to extinction. It is then tilted first about one and then about the other axis of its ellipse of elasticity. The one of these corresponding to the ordinary ray is distinguished by the resulting *slight* change in double refraction (due entirely to increase of thickness of the slide). Having determined this direction (n_0) it is only necessary to determine by use of the quartz wedge or mica plate whether this direction corresponds to the greater (positive) or less (negative) elasticity. In the case of biaxial minerals a section is sought having the highest double refraction (nearest plane of optic axes). This is now tilted until it gives the lowest possible double refraction, when the light comes through it most nearly along an optic axis. If the angle which this direction makes with the axis of least elasticity (nearly in the plane of the section) is less than 45° (half the optical angle) the mineral is positive, otherwise negative. This latter method is only approximate, but is accurate enough for minerals having an acute optical angle of 75° or less, and these are the only ones in which determination of the optical sign is of much value for purposes of identification.

Pseudochroism and Pseudodichroism.—The same author[8] furnishes an explanation of certain variations in color which are often observed in minerals having a lamellar structure when observed under the microscope. A bundle of white rays incident on any inclined plane separating two lamellæ is in part totally reflected, the reflected portion being obviously made up of more rays from the violet than from the red end of the spectrum. Of the light which is transmitted the red rays are the less refracted, and hence take their direction nearer the axis of the microscope. As a consequence the color observed near the centre of the field is due to the mixing of the red rays with the darkness due to partial total reflection, and it is, therefore, brown. Nearer the margin of the field the more refrangible rays produce green. This effect is observed in ordinary (non polarized) light, and v. Federow proposes to call it *pseudochroism*. If the polarizer is used the amount of total reflection will evidently be greatest when the direction of vibration of the incident light is parallel to the surface of incidence,

[7] Ibidem, pp. 603–605.

[8] Tscherm. min. u. petrog. Mitth., XIV, heft 6.

hence a variation in the depth of the color, called by v. Federow *pseudodichroism*, is observed when the stage is revolved. Of use in distinguishing pseudodichroic substances from truly dichroic substances is the fact that the former always show brown shades in the centre of the field.

Meteorites in Field Columbian Museum.—Farrington has prepared a "Handbook and Catalogue of the Meteorite Collection" of the Field Columbian Museum[9] modeled somewhat after Fletcher's admirable handbook describing the meteorites in the British Museum collection. The popular introduction is well written, with reference for the purpose of illustration to catalogue numbers of typical specimens in the collection. This important collection includes 180 falls or finds and the aggregate weight of the specimens is over 4700 lbs. With the exception of the Canon Diablo specimens, the largest specimens of the collection, are those from Kiowa Co., (Kan.), (466 and 345 lbs.) and the Phillips Co., (Kan.), meteorite (1184½ lbs.). The list includes 355 numbers which are described with considerable detail. Six excellent plates illustrate typical structures.

Crystallography of Wisconsin Minerals.—In a Bulletin of the University of Wisconsin, Hobbs[10] has studied the Wisconsin minerals crystallographically. The specimens are chiefly from the zinc and lead region of the southern part of the State, where they occur in the cavities of limestone, the principal species being calcite, smithsonite, cerussite, galena, sphalerite, azurite, malachite, barite, gypsum, chalcopyrite, marcasite and pyrite. Four generations of calcite are distinguished by different habits as well as by slightly different colors and degrees of translucency. These four types appear in scepter-like parallel growths. The new form 24R (24.0.$\bar{24}$.1) has a large development on two of the types. At Mineral Point and Highland galena appears in hopper-shaped octahedral as well as arborescent aggregates, and individual crystals show polysynthetic twin lamellæ according to the laws, (*a*) twinning plane a face of the octahedron and (*b*) composition plane a face of the dodecahedron. On sphalerite from Galena, (Illinois), the new form (775) was observed. The azurite of Mineral Point exhibits the new forms (307), ($\bar{2}$03), ($\bar{2}$05) and (9.12.8). The "anglesite" from Mineral Point is found to be selenite. Some new crystal habits are observed on marcasite and on cerussite.

[9] Field Columbian Museum. Publication 3, Geol. Ser., Vol. 1, No. 1, pp. 64, pls. 6, (1895).

[10] Bull. Univ. Wis., Sci. Ser., Vol. 1, No. 4, pp. 109–156, pls. 4–8, (1895).

Miscellaneous.—Hillebrand[11] has made an analysis of a tellurium ore which occurs sparingly in the Cripple Creek district of Colorado, and determined it as calaverite. The corrected analysis (disregarding traces of elements) from the Raven Mine is Fe 57.40, Au 40.83, Ag 1.77, total 100.00. The mineral is very imperfectly crystallized, but as a result of a crystallographical examination Penfield thinks it is probably triclinic but near sylvanite in angles and axial ratio. It is interesting by reason of the unusually low percentage of silver, which in the three specimens analyzed ranged from 0.90 to 3.23 per cent.—Emerson[12] notes several peculiar mineral transformations from Massachusetts. The so-called "quartz pseudomorphs" from Middlefield he finds to be serpentine pseudomorphs after olivine resembling the Snarum forms. In a boulder at Holyoke was found calcite probably pseudomorphous after common salt. A large sapphire corundum crystal from Pelham encloses a crystal of allanite which is much puckered for a distance of an inch from the allanite, but elsewhere possesses its usual parting.—v. Federow[13] finds that in the rocks of the shores of the White Sea (granites and gneisses) a vicareous relation seems to exist between plagioclase and garnet, the former being developed in large quantity only when the latter is present in small quantity and vice versa. Hobbs[14] describes cerussite from Missoula, Mont., showing the forms (110), (100), (130), (010), (001), (332), (111) and (380). The crystals are covered by a paper-thin film of galena, doubtless due to alteration through the action of sulphuretted hydrogen. Crystallized barite from Negaunee and chloritoid from Michigamme are also described.

[11] Am. Jour. Sci., Vol. L, pp. 128–131, (1895),
[12] Bull. Geol Soc. Am, Vol. 6, pp. 473, 474, (1894).
[13] Tscher. min. u petrog. Mitth., XIV. pp. 550–553, (1894).
[14] Am. Jour. Sci., L, pp. 121-128, (1895).

PETROGRAPHY.[1]

The Rocks of Gouverneur, N. Y.—An interesting feature of the biotite-hornblende gneisses[2] of the vicinity of Gouverneur, N. Y., is

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.
[2] C. H. Smyth, Jr., Trans. N. Y. Acad. Sciences, xii, p. 203.

the abundance in them of microperthitic intergrowths of orthoclase and plagioclase. From the relations of the plagioclase to the orthoclase and to the surrounding minerals there can be no doubt that it is of secondary origin. It fills cracks between quartz and orthoclase, and from these areas it sends long stringers into the orthoclase along its cleavage cracks and into its fracture lines, without suffering the least interruption in its continuity. The gneiss in its structure is sometimes granular and sometimes granulitic, and in the appearance of its constituents it shows plainly that it is a dynamo-metamorphosed rock. The dark bands occurring with the predominating light colored ones consist, as a rule, of the same minerals as the latter, but one band noted is composed of monoclinic pyroxene and hornblende in addition to the feldspars. The normal granites of the region differs in composition from the gneiss in the absence from them of hornblende, except in certain basic segregations. The granite, like the gneiss, has suffered the effects of pressure, but to a more limited extent. Among the limestones associated with these rocks are phases containing much colorless pyroxene, tremolite and scapolite. Near the base of the limestone series the pyroxene-scapolite rocks are foliated, and are apparently interstratified with unaltered beds. They consist of feldspar, quartz, pyroxene, mica, sphene, apatite, graphite, pyrrhotite and pyrite, or of these components, with the feldspars replaced by secondary scapolite.

Diorites and Gabbro at St. John, N. B.—Among the intrusive rocks cutting the Laurentian near St. John. N. B., Matthew[3] finds a granite-diorite and a gabbro. The diorite is coarse grained and porphyritic in its larger masses, and fine grained and granular in its smaller bands. Quartz, plagioclase, orthoclase, hornblende, biotite and the usual accessory constituents compose the rock, while epidote and microcline-microperthite are present in it as alteration products of plagioclase and orthoclase. The microperthite is also noted as forming a rim between plagioclase and quartz. As the rock becomes finer grained orthoclase and biotite diminish in quantity. Although the contacts of the diorite with the surrrounding rocks are usually faulted, it can be clearly seen that the latter have been altered by the intrusive. On the contact with a gabbro, this latter rock has been changed to a granular aggregate of hornblende and plagioclase. The diorite, on the other hand, is very fine grained, and is composed of an allotriomorphic mixture of plagioclase, quartz, orthoclase and a few small shreds and grains of hornblende and biotite. Limestone in contact with the

[3] Trans. N. Y. Acad. Sci., xiii, p. 185.

eruptive has been marbleized. In it are pyroxenes and garnets, the latter often in large numbers. This diorite has heretofore been regarded as a metamorphosed sediment, but, from the evidence at hand, the author concludes that it is a true irruptive. The gabbro of the region is confined to two small knobs. In one, the rock grades from an anorthosite into a peridotite. In the latter phase olivine constitutes nearly half of its mass. Hypersthene is abundant, while augite, plagioclase, and the usual accessories, spinel and magnetite, are present in small quantities. Reactionary rims always surround the olivines when in contact with plagioclase. These are composed of three zones, an inner one of hypersthene which is continuous with the large hypersthene components; a middle one, composed of fine needles of uralitic amphibole, and an outer zone consisting of uralite and a deep green, highly refracting substance in grains, probably a spinel. The contact rim is supposed to be secondary. The various phases of the rock are usually much altered into actinolitic varieties.

South American Volcanics.—The collection of Argentine volcanic rocks belonging to Berlin University has been investigated by Siepert.[4] The collection embraces quartz-porphyries, porphyrites, diabases, augite-porphyrites, melophyres and an epidiorite-porphyrite. In the quartz-porphyries quartz grains are often surrounded by aureoles of the same substance, whose optical orientation coincides with that of the surrounded particles. Many of the grains show undulous extinction, which the author regards as secondary. In some of the specimens the granophyric structure, in others the micrographitic, and in still others the felsophyric structure predominates. In many instances the granophyric structure is unquestionably secondary. The porphyrites include diorite-porphyrite, eustatite-porphyrite and epidiorite-porphyrite. In one of tha latter a feldspar granule was seen to be surrounded by a feldspar aureole. The other rocks examined present no unusual features.

Specimens of the younger volcanic rocks gathered by Sapper in Guatemala were submitted to Bergeat[5] for study. They comprise trachytes, rhyolites, dacites, andesites and basalts. The trachytes, though of the "Drachenfels" type, contain about 66 % of silicia, and are thus closely related to the rhyolites. The andesites are the most abundant types. They include pyroxene, hornblendic and mica hornblende varieties. Some of the pyroxenic andesites contain two pyrox-

[4] Neues Jahrb. f. Min., etc., B. B., ix, p. 393.

[5] Zeits. d. deutsch. geol. Ges. xlvi, I, p. 126.

enes—a hypersthene and an augite, both of which are pleochroic in the same tints parallel to *B* and *C*, a difference of color being noticeable only in the direction of *A*. The author notes that the volcanoes on the principal fissures have eruptive andesites, while the others have yielded basalts.

Rock Classification.—A new classification of in organic rocks, based on the nature and past history of their components, is proposed by Milch.[6] The original rocks are the *archaiomorphic*, embracing those whose constituents have separated from a molten magma. Through alteration processes these have given rise to the *neomorphic* rocks, including the three groups: *anthi-lytomorphic*, *allothi-stereomorphic* and *anthi-neomorphic*. The first of these groups includes those rocks whose material was originally in some other condition, but whose constituents possess forms independent of outside influences, as, for instance, the chemical precipitates. The second group embraces those whose material has been transported and been laid down with its own form to produce a rock different from the original one, as the mechanical sediments. The third group comprehends rocks whose material is in its original position, but in a different condition from the original one, as in the case of the residual and metamorphic rocks.

Miscellaneous.—Levy and Lacroix[7] describe a Carboniferous leucite-tephrite from Clermain, that is associated with micaceous porphyrites. The tephrite contains large leucites and pyroxenes in a groundmass composed of biotite, augite, plagioclase and leucite. All of this latter mineral, whether in large or small crystals, is transformed into aggregates of albite.

Palache[8] announces the discovery of riebeckite and aegerine in the

[8] Neues Jahrb. f. Min., etc, 1895, I, p. 100.

Forellen granulite of the Gloggnitzer Berges, near Wiener-Neustadt in Austria. The rock is a typical granulite, consisting of a quartz-plagioclase aggregate in which are imbedded acicular crystals and grains of the amphiboloids mentioned.

[6] Neues Jahrb. f. Min., etc., B. B., ix, p. 129.

[7] Bull. Soc. Franc. d. Min., xviii, p. 24.

GEOLOGY AND PALEONTOLOGY.

A Batrachian Armadillo.—The significance of certain fragments which I observed several years ago in Permian material from Texas, has been established by a more complete specimen which I have received from the same locality. This consists of a portion of the skeleton, which includes ten consecutive vertebrae and their appendages, of the rhachitomous type, similar in general to those of Trimerorhachis. The genus differs from Trimerorhachis in this important respect. The neural spines are elevated, and the apex of each sends a stransverse branch which extends in an arch on each side to the ribs. These spinuous branches touch each other, forming a carapace. Above and corresponding to each of them is a similar dermal osseous element, which extends from side to side without interruption on the median line, forming a dermal layer of transverse bands which correspond to the skeletal carapace beneath it. To this remarkable genus I propose to give the name of Dissorophus. It is a veritable batrachian armadillo.

As to species characters, it is to be remarked that the intercentra are longer in proportion to their width than in the *Trimerorhachis insignis*. The heads of the ribs have a small free truncate angle below their capitulum. The extremities of the spinous roof-processes are free from each other for a short distance, and each has a depressed rounded sharp edge. The dermal bands above them terminate a little proximad of them and in a similar manner, and their extremities are closely appressed to the surface of the band below them, with which they slightly alternate. Their surface is very coarsely rugous, with ridges and fossae, whose long axes agree with those of the segments. This species I propose to call *Dissorophus multicinctus*. Length of ten vertebrae in place 93 mm.; width of intercentrum 16; length of do 9; elevation to roof 30; thickness of carapace 8; width of a carapacial band 9; length of do on curve 75. The species appeared to have been about the size of the Japanese salamander *Megalobatrachus maximus*.

The genus Dissorophus adds another to the remarkable forms already known from the American Permian. It is remotely approached by the genus Zatachys Cope, where a dermosseous scute is coössified with the apex of the neural spine.—E. D. Cope.

Cope on the Temporal Part of the Skull, and on the systematic position of the Mosasauridæ—A reply.—In the September Number of this Journal Prof. Cope has published a review

of two of my papers (Bemerkungen über die Osteologie der Schläfengegend der höheren Wirbelthiere Anat. Anz. x, 1894, pp. 315–330 and: On the Morphology of the Skull in the Mosasauridæ, Journ. Morphol. VII, 1892, pp. 1–22, pl. I–II), to which I should like to make some remarks.

1. *The Paroccipital.*

The bones of the temporal region in question I have termed squamosal, prosquamosal and quadratojugal. Cope states that I adopted the name prosquamosal (Owen, 1860), because the name supratemporal was used previously for a different element peculiar to the Teleostomous fishes. But this was not the only reason; the principal reason was, that with the name supratemporal, totally different elements were designated in the Stegocephalia and Ichthyosauria and in the Lacertilia (Anat. Anz. x, 1894, p. 320.)

Cope has called the three bones, the paroccipital, supratemporal and zygomatic, "after earlier authors" as he says. But the paroccipital is not the squamosal, the name supratemporal is misleading as stated before; and the name zygomatic has been used since the beginning of Anatomy, for the jugal or malar; how can Prof. Cope use this name for the quadrato-jugal? I thought I had shown once for all, that the opinion held by Prof. Cope, that the squamosal of the Squamata is homologuous to the paroccipital (opisthotic) is wrong. But it seems, that he is not convinced. He is, however, the only one among all living morphologists who has this opinion.

He believes that the exoccipital together with the paroccipital process in the Reptilia in which there is no free paroccipital (Ichthyosauria, Testudinata) represents the exoccipital alone. He states that nobody has ever found the paroccipital process as a separate ossification. But he is wrong about this: The free paroccipital, uniting later with the exoccipital and forming the paroccipital process has been first described, as far back as 1839, by Rathke[1]; in *Tropidonotus natrix* and this passage has been translated by Huxley in his well known Croonian lecture on the Theory of the Vertebrate Skull, delivered the 18st of November, 1858 before the Royal Society. It was also described by Leydig[2] in *Anguis fragilis*, in 1872.

[1] Rathke, Heinrich Entwicklungsgeschichte der Natter. Königsberg, 1839, pp. 201-202.

[2] Leydig Franz. Die in Deutschland lebenden Arten der Saurier. Tübingen, 1872, p. 26.

The paroccipital has been described in *Sphenodon* by me in 1889[3] in the following words. "In the old animal supraoccipital, exoccipitals, paroccipital, petrosals are united, but on the young all these elements are free. There is much cartilage between the supraoccipital and the petrosal and paroccipital. The paroccipital is united to the exoccipital by suture, the elements in question of a young *Sphenodon* resemble those in Chelone and especially in Ichthyosaurus." I may state here, that in a skull of *Sphenodon*, of 50 mm. in length from anterior end of premaxillary to occipital condyle, the suture between exoccipital and paroccipital is quite distinct, and also the characteristic Y-shaped sutures between the paroccipital, supraoccipital and petrosal.

Siebenrock[4] has independently, not knowing my paper in the Journal of Morphology, found out the same in *Sphenodon* and has given very good figures of the conditions. He has also shown in an absolutely convincing way,[5] that in the Lacertilia the paroccipital process is also homologuous to the paroccipital, and has given excellent figures demonstrating it. These two papers were mentioned by me in the paper published in the Anatomischer Anzeiger, discussed by Prof. Cope, but he certainly did not consult the papers, which are easily accessible.

After this demonstration of the free nature of the paroccipital in *Sphenodon* I think Prof. Cope will have to give up his view on the homology of the paroccipital of the Testudinata with the squamosal of the Lacertilia. I do not understand, how Prof. Cope could fall into such a fundamental error. We know since Hallman and it has since been redemonstrated dozens of times, that in the Reptilia and Birds, the semicircular canals of the ear are placed into 3 bones: 1, the petrosal; 2, the supraoccipital and 3, the paroccipital. These 3 bones come together and form that exceedingly characteristic Y-shaped suture, first mentioned by Hallman, and fully discussed by Huxley in his lectures on the Elements of Comparative Anatomy, London, 1864.

He already stated in his Croonian Lecture: "when the petrosal, mastoid (paroccipital) and squamosal are determined in the turtle, they

[3] Baur, G. On the Morphology of the Vertebrate Skull. Journ. Morph., III, 1889, pp. 467–468.

[4] Siebenrock, Friedrich. Zur Osteologie des Hatteria-Kopfes. Sizungsberichte d. Kais. Akad. Wiss. Wien. Mathem. naturw. Cl. Bd. CII, Abth. I, Juni, 1893, pp. 7–10. Pl. fig. 3. 5.

[5] Siebenrock, Friedrich; Das Skelet der *Lacerta simonyi* Steind., und der Lacertiden familie überhaupt; Sizungsb. d. Kais. Akad. Wiss. Wien. Mathem. naturw. Cl. Bd. CIII, Abth. I. April, 1894, pp. 4–9, Fig. Pl. III.

are determined in all the Reptilia. But the Crocodilia, Lacertilia Ophidia, differ from the turtle and Chelonia generally, in that their mastoid (paroccipital) is, as in the bird, anchylosed with the exoccipital." The matter is so simple and clear, that it can be demonstrated to any student who begins his work in Osteology.

Prof. Cope also states, that he has been hitherto alone in the opinion that the suspensorium of the quadrate of the Ophidia is the squamosum of the Lacertilia, but he forgets that this opinion was held already by Spix[6] in 1815. who has given excellent figures of these conditions in Lizards and Snakes; by Hallmann, Troschel, Gegenbaur and many others before 1870, when Cope read his paper.

Prof. Cope believes that the squamosal (his paroccipital) in the squamate can not be homologous with the squamosal in the Ichthyosauria, Colylosauria and Stegecephalia, with which it is identified by me, since it is a brain-case bone, while the latter is a temporal roof-bone, a fundamental difference, as he says. I never knew that the squamosal (paroccipital, Cope) of the Squamata is a brain-case bone, it is certainly not in the many skulls I have examined, but is homologuous to the squamosum of the Stegocephalia and Ichthyosauria is shown by *Saphœosaurus* which bridges over *Sphenodon* with *Ichthyosaurus*. In regard to the homologies and nomenclature given in my paper in the Anat. Anz. I have not to change a single point.

2. *The systematic Position of the Mosasauridæ.*

"Like Owen, Marsh and Dotto, he [Baur] does not perceive that this group (Mosasauridæ) is essentially distinct from the Latertilia, and concludes with them that I have erred in alleging it to present affinities to the Ophidia." Cope, p. 857.

In order to determine this matter, Prof. Cope, thinks it necessary to know, what the characters are that distinguish snakes from Lizards. The first character, the descending of the parietal and frontal bones to the basicranial as is in the Ophidia is as he admits himself, not constant, being found also in the Amphisbænians and Anniella.[7]

As a second character he mentions, that the prosquamosal (supratemporal) is present in the Lacertilia, but absent in the Ophidia, stat-

[6] Spix J. Baptista, Cephalogenesis, sive capitis ossei structura. gr. fol. Monachii, 1815.

[7] I may mention here the interesting fact that in some Amphisbænians, the parietals and frontals are connected by a especial element with the basisphenoid, in other genera they unite with this element. The basisphenoid of snakes is also a composite of this bone and the basisphenoid proper.

ing the Amphisbænians and Anniellidæ to be exceptions; but the Geckonidæ and Uroplatidæ also lack the prosquamosal. Therefore, this character does not hold.

A third distinction according to Prof. Cope is that the quadrate bone is supported by the paroccipital [squamosum] in the snakes, and the exoccipital [paroccipital] in the Lizards. In the Mosasauridæ the squamosal (paroccipital) is said to be more largely developed than in the Lacertilia, and that it supports the quadrate bone as in the Ophidia.

This is by no means correct. It is the squamosal (paroccipital, Cope) which supports the quadrate in most of the Lacertilia; in some forms only, the paroccipital (exoccipital, Cope) takes part (Chamæleon). But in many Lizards, the Iguanidæ for instance, the paroccipital processes do not support the quadrate at all. This character, therefore, falls to the ground. I can not see any principal difference in the relation of the squamosal (paroccipital, Cope), the paroccipital (exoccipital, Cope) and quadrate in the Mosasaurs and the Iguanidæ. In the squamosal (paroccipital, Cope) of *Platecarpus* (fig. 20, 21, Pl. II) of my paper we can distinguish 3 portions: first, an upper one, which joins the parietal processes; second, an inner one which is suturally united with the paroccipital and petrosal, and a lower one, which supports the quadrate.

In a skull of *Conolophus* (Iguanidæ) before me, I find very similar conditions, the inner process only is not so much developed, but it reaches the petrosal. The differences enumerated by Prof. Cope between the Lacertilia and Mosasauridæ do not exist; and I can not discover one trace of a character of the snakes. The phlogenetic conclusions of Prof. Cope are not supported by the facts. I believe as firmly as formerly, that the Mosasauridæ are true Lacertilia adapted to aquatic life; and that their closest living representatives are the Varanidæ. The Varanidæ have retained the terrestrial limbs, and the free nasal bones but have lost the postorbital bar. The Mosasauridæ have required fins with digits[8] with numerous phalanges, the nasals have become united with the premaxillaries, but the postorbital arch has been retained.

[8] In a specimens of *Thorosaurus*, which I have lately examined through the kindness of my friend, Prof. S. W. Williston, Lawrence Kas. I find in the forelimb the following number of phalanges.

1st. digit 5 (+3); probably 8, the 5 proximal ones are preserved.
2nd. digit 7 (+2); probably 9, the 7 proximal ones are preserved.
3rd. digit 9 (+1); probably 10, the 9 proximal ones are preserved.
5th. digit 10 (+1); probably 11, the 10 proximal ones are preserved.
5th. digit 11 or 12; all preserved, but some covered up.

Reply to Dr. Baur's critique on my paper on the Paroccipital bone of the Scaled Reptiles and the Systematic Position of the Pythonomorpha.—In the following pages I continue the discussion of the questions raised by Dr. Baur in his papers.

I. The Paroccipital of the Squamata.

Dr. Baur in the paper just preceding reiterates the opinion that the parotic process of the exoccipital bone of the scaled reptiles includes the paroccipital element, and that I have fallen into a serious error in supposing that his squamosal is the true paroccipital. He cites various authorities against me and intimates that I am not familiar with the literature, which he says is accessible. In this last statement he is undoubtedly correct, as the greater part of it is in my private library.

I must call my critic's attention at the outset to the fact that my last paper has reference to the elements which support the quadrate bone, and not to the presence or absence of the opisthotic element of Huxley. It was not necessary, therefore, to enter into an exposition of the evidence for the existence of the latter which, as he says, has been proven by Siebenrock and Leydig in the lizards, Rathke in the snakes, and himself and Siebenrock in the Rhynchocephalia. It is the element which supports the quadrate bone for which the name paroccipital (Owen) is appropriate, while the element which includes the posterior semicircular canal is the opisthotic of Huxley.

Baur asserts that the so-called parotic process of the exoccipital which supports the quadrate in the Squamata is the same element as that termed opisthotic by Huxley. This I deny, and believe that in this it is Baur and not myself who has fallen into error. Siebenrock instead of asserting this to be the case, denies it in the following language:[9] "It is not the processus paroticus of the pleuroccipital (exoccipital) which is homologous with the (paroccipital Owen) opisthotic Huxley, but the portion anterior to the foramen nervi-hypoglossi superius which protects the organ of hearing." Siebenrock here uses the names of Owen and Huxley as referring to the same element, but he makes the clear distinction, which is the important point, between the parotic process of the exoccipital and the element which contains the posterior semicircular canal. What then is the element which articulates with the quadrate in the different orders of the Reptilia?

In the Testudinata, and, according to Baur, in Sphenodon,[10] the

[9] Sitzungsber. Wiener Akademie, 1894, p. 285; On the Skeleton of *Lacerta simonyi*.

[10] Siebenrock, Sitzungsberichte Wiener Akad. Wiss, 1893, p. 254.

element which extends externally from the exoccipital to the quadrate is continuous with the opisthotic, but the semicircular canal is included in its proximal part only. Here the structure is entirely different from that which characterizes the Squamata, where the opisthotic does not extend distad of the canal and fuses early with the exoccipital. This character is to be added to those which distinguish the Rhynchocephalia from the Squamata. The paper which Dr. Baur criticizes above had reference to the Squamata, and the question at issue is what is the element attached to the end of the parotic process of the exoccipital in this order, which I call paroccipital, and which Dr. Baur calls squamosal. That it is not the opisthotic is clear enough.

The reasons for supposing that the element which I call paroccipital in the Squamata is really such, are as follows. In the orders Testudinata and Rhynchocephalia, where a continuous element extends from the posterior semicircular canal to the quadrate, this so-called paroccipital is not distinct. In the Squamata, where the opisthotic is restricted to the region of the canal and does not reach the quadrate, this so-called paroccipital is distinct. It becomes then probable that the paroccipital of the Squamata is represented by the distal, non auditory part of the element whose auditory portion is the opisthotic of the Testudinata and Rhynchocephalia. This hypothesis is confirmed by the structure in the Pythonomorpha, which is intermediate between that of the two types mentioned. The paroccipital extends proximad to the position of the opisthotic and petrosal, which it does not do in the Lacertilia or the Ophidia.[11]

Neither Owen nor Huxley distinguished the single element of the Testudinata as composed of two. The name paroccipital is the prior, and I have retained it for the distal or quadrate portion, while Huxley's name of opisthotic belongs to the auditory portion for which he designed it. The direct evidence for such a primitive division of this element in the Testudinata has, however, yet to be produced, and I am entirely willing to give up the view above defended should it turn out on further investigation to be untenable.

II. The Affinities of the Pythonomorpha.

No one who has examined carefully the relations of the paroccipital to the surrounding proximal elements in this suborder and compared them with their relations in the Lacertilia, can fail to see the important difference between the two. My opportunities of studying

[11] See Transac. Amer. Philos. Soc., 1892, p. 19, where the structure in Mosasaurus is represented in fig. 3.

these characters have been good, including the principal collections of European Museums and those of this country. I have at hand crania of all but one or two of the North American genera of Lacertilia, and the principal ones of all other countries, and I maintain that the difference between them and the Pythonomorpha is universal. I maintain, contrary to Dr. Baur's statement, that in all Lacertilia the exoccipital supports the quadrate, and that in the Pythonomorpha and the Ophidia the exoccipital does not support it or generally touch it. I also maintain that the paroccipital (squamosal Baur) does support the quadrate in the Ophidia, while it is only in contact with a very small part of it in the Lacertilia. This assertion is true of the Iguanidae as well as of all other Lacertilia. Of this family I have many crania. These do not include Conolophus, to which Dr. Baur refers, but I have the nearly allied genus Cyclura, which has the character of other Lacertilia in this respect. Steindachner's figures of Conolophus show that it closely resembles Cyclura in the point in question, and I have no doubt that if Dr. Baur will take to pieces the proximal articulation of the quadrate of Conolophus as I have done in Cyclura, he will find an articular facet on the exoccipital and none on the paroccipital (squamosal). In fact the quadrate extremity of the paroccipital in Lacertilia is so insignificant, and the proximal end of the quadrate is so considerable, that the support of the latter by the former is a mechanical impossibility. Since the articulation of the quadrate in Pythonomorpha, of which I have seen all the American genera, is exclusively with the paroccipital, it is clear that the distal as well as the proximal relations of that element are different from those of the Lacertilia. On the other hand the relations to the quadrate are the same in the Pythonomorpha as in the snakes, and the proximal articular characters are approached by the Tortricid snakes more nearly than by any lizard. In the distal articulation of the paroccipital with the supratemporal, the Pythonomorpha and lizards agree, as was long since pointed out by authors.—E. D. Cope.

Recent Elevation of New England.[12]—I submitted some conclusions to the American Association for the Advancement of Science in advance of the preparation of a detailed paper upon this subject. Indeed in a discussion of a paper by Prof. C. H. Hitchcock before the Baltimore meeting of the Geological Society of America (December 1894) the present writer called attention for the first time to certain terrace phenomena which might be used as a yard stick in

[12] Read by J. W. Spencer at the Springfield meeting of the Am. Ass. Adv. Sci.

measuring recent terrestrial elevations. Since that meeting I have gone over many critical localities and the phenomena confirm the conclusions then announced. The importance of this contribution is not so much in a determination of the magnitude of post-glacial elevation as in finding a means of physical measurement of it and in my consequent challenge of the doctrine of ice dams in the late formation of high-level beaches and terraces. For no apparent reason has the structure of the terraces escaped early observation to such a degree that hitherto it has not been described in such a way as to be used as a meter of recent terrestrial changes of level.

The structure may be briefly set forth. The terraces are not those of the sloping rivers, but are the much more horizontal remains of water plains. The platforms do not merge from one step to the next below and thus make the ancient slopes of the rivers as has been often assumed, but they abruptly descend as steps to the lower plains. Thus a small meadow widens out into a broad flat, with the river near the surface of the plain along the upper part of the flat, but further down, it descends to greater depths below the same floor or plain, which on being eroded become a lateral terrace bounding the still lower plains. Thus as meadows, plains and remanie terraces, the same platforms may often be traced for many miles in length, disappearing owing to erosion, and to the distance of the terraces from the source of supply of sands and gravels. The terraces often cross the country and extend from one valley to another. Subject to certain corrections, these meadows, flats, and terraces mark the lowering of the base planes of erosion, or in other words indicate the elevation of the land. That is to say, the land has approximately been elevated as much as the sum of the heights of the terrace-plains one above the other. In some places, these are situated only a few feet apart in elevation, yet in other localities several of the steps are so combined that the great terraces may be from 50 to 250 feet above the river. Occasionally, in the course of a few miles, scores of terraces, may be ascended or descended and counted with certainty. Yet at any one locality, there are seldom more than four or five lateral terraces distinguishable; but these four or five are not identical with the four or five platforms observed several miles away, in the same great valleys.

Such distinct terraces are seen to an elevation of 2700 feet at the base of Mount Washington, with terrace material much higher, but without the preservation of the structure upon the steep mountain slopes. The terrace forms described have now been observed under so many

conditions and over such a wide extent of territory that they appear to be the prevailing conditions and not exceptional.

Did these accumulations in the great valleys, often two miles or more in width, occur only on the northern and western sides of the high lands the theory of glacial drains might be supported. But they also occur on the southern and eastern sides of so many mountain masses so as to preclude the idea of their formation in glacial lakes. And the author has found the same structure within a few degrees of of the equator.

The platforms are commonly cut out of till deposits filling preglacial valleys, and are covered with sands and gravels. From these evidences, the author concludes that the New England Mountain regions have been elevated at least 2700 feet in the post-glacial epoch, or in other words the post-glacial submergence was at least 2700 feet in New England, but much less farther westward. Although this great continental movement has so recently occurred, yet the magnitude of the coastal changes have not yet been fully considered, but it was probably much less.—J. W. SPENCER.

BOTANY.[1]

Sacaline.—Under this name a species of *Polygonum* (*P. sachalinense* F. Schmidt, from Saghalin Island) has been freely advertised in this country within the last six months as a forage plant, especially adapted to the conditions which prevail upon the Great Plains. Extravagant claims as to its great value were made by dealers who wished to supply the farmers with roots or seeds. It was said that from one hundred to nearly two hundred tons of the plant could be grown upon an acre, and the forage yielded by it was said to nearly or quite equal that of Alfalfa or Red Clover in nutritiousness.

For two years the writer has watched carefully a clump of this plant growing upon a favorable spot upon the campus of the University of Nebraska. In spite of the fact that the plants have had better care than they would have in an ordinary field, they have made but a moderate growth, at no time exceeding three feet in height. The clump is moderately ornamental, about as much so as a fine growth of dock (*Rumex*), and less so than rhubarb (*Rheum*). The foliage is neither dense nor abundant, while the stems and branches are very

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

tough and hard; the latter are evidently unfit for forage, while thus far no animals have shown any disposition to eat any part of the plant.

While it blossoms freely late in the summer, it has not produced seeds. It is slowly spreading under the ground by its creeping root. stocks.—CHARLES E. BESSEY.

Saccardo's Sylloge Fungorum.—The eleventh volume of this work has recently appeared. It contains 4220 additional species, scattered through the whole of the fungi. Many of the descriptions are rather badly mutilated, often being reduced to little more than mere measurements. This suggests that the author may have become weary of his work, and that we have in this volume the last of the Sylloge. The total number of species thus far described in the eleven volumes of the Sylloge is 42,383.—CHARLES E. BESSEY.

North American Fungi.—The thirty-third century of Ellis and Everhart's "North American Fungi" appeared not long ago. The former excellence of this standard distribution is fully maintained in the present volume. The more important genera represented are *Cercospora* (5 species), *Phyllosticta* (8 sp.), *Puccinia* (3 sp.), *Ramularia* (4 sp.), *Septoria* (11 sp.), and *Valsa* (5 sp.).

Hough's American Woods.—This distribution of wood sections has reached Part VI, bringing the number of species thus far represented up to about one hundred and fifty. The part before us is devoted to the woods of the Pacific Coast. The species represented are *Rhamnus purshiana, Aesculus californica, Cercidium torreyanum, Prosopis juliflora, Cercocarpus parvifolius, Garrya elliptica, Arbutus menziesii, Arctostaphylos pungens, Chilopsis saligna, Platanus racemosa, Quercus garryana, Quercus agrifolia, Quercus densiflora, Castanopsis chrysophylla, Salix lævigata, Libocedrus decurrens, Sequoia gigantea, Sequoia sempervirens, Taxus brevifolia, Torreya californica, Pinus lambertiana, Pinus ponderosa, Pinus contorta, Picea sitchensis, Pseudotsuga taxifolia.* These sections should find a place in the collections of every botanical department of the universities of the country, and for the forestry departments of our agricultural colleges they are indispensible.

CHARLES E. BESSEY.

Seymour's Grasses and Grass-like Plants of North America.—The second half-century of this useful collection was sent out during the summer. The numbers from 51 to 61, inclusive, include sedges, the remainder being true grasses. The specimens are

large and well dried, and the labels are full and of neat form and size. Occasionally, a specimen is somewhat deficient in roots, a fault which may easily be avoided in subsequent issues.—CHARLES E. BESSEY.

VEGETABLE PHYSIOLOGY.[1]

Saccardo's Color Scale.—The learned author of the Sylloge Fungorum has issued a second improved edition of his color scale (*Chromotaxia seu nomenclator colorum polyglottus additis speciminibus coloratis ad usum Botanicorum et Zoologorum.* Editio altera. Patavii, Typis Seminarii, 1894) which is very useful and ought to be in the hands of every botanist. The pamphlet contains 22 pages of Latin text and two well executed tables of 25 colors each. The text gives in regular order, from left to right: (1) The Latin name of the type color. (2) Latin synonyms. (3) Latin names of colors approaching the typical color. (4) Italian names. (5) French names. (6) English names. (7) German names. (8) Explanatory remarks. To illustrate, we have under the first entry: "Albus. Candidus, niveus, ermineus, virgineus, calceus, gypseus, cretaceous, cerussatus, olorinus. Albatus, albicans, albidus, albidulus, albineus, albinus, albulus, eburneus; pallidus, pallens, pallidulus; lacteus, lacticolor, galactites, galochrous; argenteus, argyraceous; candicans, canescens. Bianco, eburneo, pallido, latteo, argenteo, canescente. Blanc, blanc d'ivoire, pâle, blanc de lait, argentin. White, ivory-white, pallid, milk-white, silver-colored. Weiss, elfenbeinweiss, blass, milchweiss, silberfarben. Typical examples: *Lime, gypsum, snow, white lead, ermine.* Pallidus is an impure white. Argenteus, argyreus (from *argyros*, silver) is a metallic, shining white. Lacteus is the color of fresh cow's milk. Galactites, galochrous are from *gala*, milk. Candicans, canescens is pure or impure white resulting from a tomentum such as on the under side of the leaf of *Populus alba* or *Alnus incana.* Olorinus (from *Cygnus olor*) is a pure shining white (example *Clitocybe olorina*)." An examination of the color scale cannot fail to deepen the impression that it is futile to attempt to use color terms in natural history without referring them to some particular scale or standard. On first thought, nothing seems less likely to be misunderstood than such terms as flesh-

[1] This department is edited by Erwin F. Smith, Department of Agriculture, Washington, D. C.

color, bay, or chestnut, and yet these names and many others call up quite different conceptions in different minds, and, where much depends on the accurate description of colors, are sure to mislead, unless referred to some exact color scale or well known object or substance of invariable color. In this particular scale, for example, *ater* does not represent the usual conception of a lusterless coal black, but is a lighter color between plumbeous and slate; *latericius* is not the color of any bricks commonly found in this country, but rather what the writer would designate a light chocolate; *badius* is scarcely the color of a bay horse; and *incarnatus* is certainly *not* the lively color of the lips. These matters, however, are trifles provided the colors of the scale are made from pigments that will be permanent and provided those who use it as a guide remember that it represents in many cases not the universal concept of particular colors but only the author's, and specify accordingly, e. g., "*violaceus* Sacc., No. 47." It is to be regretted that directions for reproducing these colors are not given. To see how widely color concepts vary, even among distinguished naturalists let the reader compare Saccardo's hazel (7), isabella (8), chestnut (10), scarlet (15), cream-color (27), emerald green (36) glaucous green (38), violet (47), and lilac (48) with Ridgway's numbers, IV 12, III 23, IV 9, VII 11, VI 20, X 16, X 17, VIII 10, and VIII 19 which bear the same names but are by no means the same colors. Evidently the perfect color scale is yet to be put upon paper, and owing to defects in pigments is not likely to appear soon. Meanwhile we may be thankful for those we have, using them as intelligently as possible, and never forgetting to specify, in cases where color is important, the particular scale in which a similar color may be seen. Saccardo's scale has a special value to mycologists, since it affords the users of that immense and indispensable work, the Sylloge Fungorum, a ready means of determining in a thousand and one descriptions exactly what color is meant, provided, of course, the author has used the terminology of this scale consistently throughout.—Erwin F. Smith.

Kroeber's Transpiration Experiments.—It will be remembered that Müller-Thurgau believed he had demonstrated the amount of transpiration-water to be different in different varieties of vines and orchard trees, and that this fact could be turned to practical use by horticulturalists who, in dry soils or climates; should plant varieties, making small demands on transpiration, and in moist ones those transpiring abundantly. Very recently Mr. E. Kröber, assistant in the plant-physiological experiment station of the Königliches Lehranstalt

at Geisenheim on the Rhine, has gone over the same ground in a long series of experiments (Ist die Transpirationsgrösse der Pflanzen ein Maassstab für ihre Anbaufähigkeit? *Landw. Jahrb.*, Bd. 24, 1895, H. 3, pp. 503–537) which throw doubt on Müller-Thurgau's methods and lead to the following opposite conclusions: (1) In determining the amount of transpiration the entire decrease in weight of the plant and apparatus must be taken into account and not simply the decrease of water in the flasks, since under pressure, in short experiments, the error resulting from the forcing into the wood of water which is not transpired is very considerable. (2) The demonstrated transpiration of any branch can *never* be taken as a measure of the transpiration of the whole tree. (3) The amount of transpiration of different branches of the same tree may be wider apart in many cases than that of branches of different trees or even of different varieties. (4) In parallel experiments, under exactly the same transpiration conditions, the ratio of the amount of water given off by different branches is by no means constant. (5) The influence and interchange of the different factors governing transpiration is quite different in different individuals. (6) The present condition of the individual and the circumstances under which it previously transpired have a great influence upon transpiration. (7) It follows that the amount of transpiration of a single individual cannot be regarded as a measure of the water requirements of the whole variety. According to the writer, Müller-Thurgau has also left out of account the capacity of individuals and varieties to adapt themselves to changed conditions.—Erwin F. Smith.

ZOOLOGY.

A Stratified Lake Fauna.—One of the most interesting results achieved by the naturalists of the Russian Biological Station on the island of Solowetzk in the North Sea, has been the discovery of a remarkable lake on the island of Kildine in the Arctic Ocean. This lake, which is completely separated from the sea by a narrow strip of land, was discovered by the Russian naturalist, M. H. Herzenstein, who was struck by finding in the lake a fish which is exclusively marine in habit, namely, the common cod. Further observations by MM. Faussek and Knipowitsch have elucidated the peculiar features of the fauna of the lake. On the surface the water is fresh, and is in-

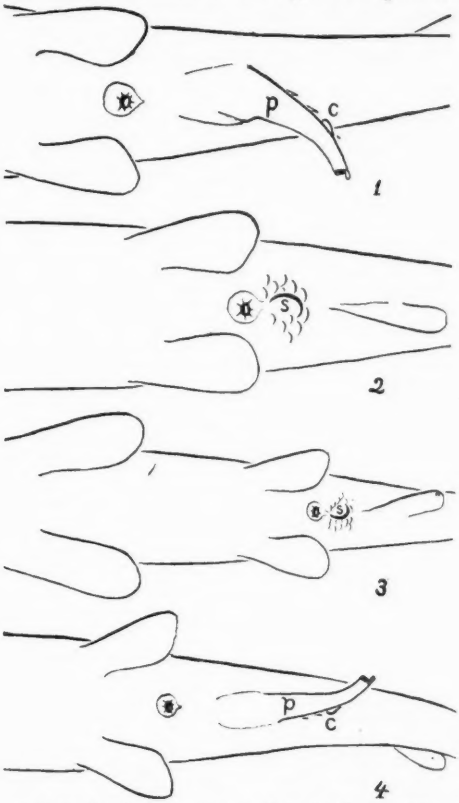
habited by fresh water animals, such as Daphnids, etc.; this water is brought to the lake by streams from a neighboring marsh. Under the superficial layer of fresh water is found salt water, supporting a Marine fauna—Sponges, Sea-anemones, Nemertines, Polychætes, marine Molluscs, Starfish and Pantopods. There is even a regular littoral zone beneath the fresh water, characterized by small Fuci.

The bottom of this lake is covered with mud exhaling an odor of sulphurretted hydrogen, and is not inhabited. The water of the lake shows a slight ebb and flow, attaining a vertical height of only a few inches, while the tides in the adjacent sea are considerably greater. This fact would appear to point to the existence of some subterranean communication between the lake and the sea. (Nature, July, 1895.)

Sexual Rights and Lefts.—The genus Anableps includes several species of the most extraordinary of the fishes. With other novel characters, they have the eye divided into a lower section, looking downward, and an upper protruded above the head conveniently for seeing on the surface of the water; the pelvis also is divided; and the young are retained in the ovary until well developed. Our present, interest, however, concerns only their means of fertilization. In a study of the Cyprinodonts (Monograph published as Vol. XIX, No. 1, of the Memoirs of the Museum of Comparative Zoology, from which this item is repeated) particular examinations of the anal fin of the males, which is modified into an intromittent organ, disclosed the fact that its structure adapts it for sidewise motion, rather than vertical. Directing attention to the species *A. anableps* of Linné (*A. tetrophthalmus* of others), comparisons of the males showed that this organ differs in individuals, being functionally dextral on about three-fifths, and sinistral on about two-fifths of the specimens. Among the females in the Museum's collection a similar state of affairs exists, but with the numbers reversed, two-fifths of them being rights and three-fifths lefts. Once possessed of the facts, dextrals and sinistrals are easily recognized. Happily Professor Agassiz, on his Brazilian Expedition, had provided a considerable amount of material to compare.

Of the accompanying diagrams, figure 1 represents the lower side of the hinder portion of a dextral male, figure 2 that of a sinistral female, figure 3 that of a dextral female, and figure 4 that of a sinistral male. In its posterior half the anal fin of the male (*p*), the sexual organ, is bent to the right on dextrals (1), or to the left on sinistrals (4); it has on the convex side of the bend a small fleshy tubercle or gland (*c*), while the urogenital tube lies along the concave side. The opening to

the oviducts of the female, behind the vent, is covered by a larger scale (*s*), a foricula (a diminutive shutter), which opens to the right on



dextral (3) and to the left on sinistral individuals (2). Evidently copulation is effected by a right male at the left side of a left female, and by a left male at the right side of a right female, the anal (*p*) of the male being turned so as to bring its tip under the free edge of the foricula (*s*) into the mouth of the oviducts.

From the specimens examined it would appear, at sight, as if the male sex was eventually to become dextral and the female sinistral, and as if by selecting rights or lefts one might exclusively raise either rights or lefts as he chose; but the proportions of the sexes, and of dextral and of sinistral of each sex, in the progeny are really deter-

mined by tendencies in the ovary, tendencies which may vary from connection with different males, from food, temperature, etc. To bring about a variety in the species, all the males of which might be rights, or all lefts, the females to suit, choice would have to be made of individuals actually producing the required forms, and of particular conditions, in a measure disregarding the right or left of the parents. And this introduces a great many complications into the selection problem. Another question of interest relates to the origin and development of the unusual features. Some light is thrown upon this by an allied genus in the family, of which the males alone appear to be rights and lefts. Excepting these genera, no other creatures are recalled that are in the particulars under notice similar to these peculiar fishes. Though less extravagant, the species of Anableps are suggestive of the fanciful birds in the stanza translated by Moore, as he tells us, from the Persian, alluding to the "Jaftak," "a sort of bird that is said to have but one wing, on the opposite side to which the male has a hook, and the female a ring, so that when they fly they are fastened together:"

> "How can we live so far apart?
> Oh, why not rather heart to heart,
> United live and die,
> Like those sweet birds that fly together,
> With feather always touching feather,
> Linked by a hook and eye!"
>
> —S. GARMAN.

The Bats of Cuba.—Of the twenty species of bats observed by Dr. Gundlach in Cuba, nineteen have been recorded by him in his paper entitled "Contribucian á la Mamalogia Cubana." He places them in two groups, as follows: I. Species with a nose-leaf or with fleshy wrinkles over the nostrils or around the mouth. They hang themselves during the day by the hind legs. They eat insects and fruit. The following genera are included: Macrotus, Monophyllus, Phyllonycteris, Artibeus, Phyllops, Brachyphylla, Mormops, Chilonycteris, Noctilio. II. Species without a nose-leaf and with no wrinkles about the mouth. These sleep in crevices and do not hang themselves by the hind feet. They eat only insects. The following genera are included: Molossus, Nyctinomus, Natalus, Vesperus, Nycticejus, Atalapha. (Abstr. Proceeds. Linn. Soc. New York, No. 7, 1895.)

Fatigue and Toxicity.—A series of experiments carried on by M. Redon show the toxicity of the blood of cattle that have died of

fatigue. The arrival at the abattoir (Paris) of a consignment of cattle from South America gave opportunity for the experiments. Five individuals died after a panic stricken race. The autopsy revealed that the animals had suffered from both hunger and thirst during the long journey. Of three rabbits inoculated with the serum of the dead cattle the first, injected with a dose of 12 cubic centimeters, died in five hours; the second, inoculated with 5 cubic centimeters, was seized with a violent diarrhœa, which terminated its life at the end of the fifth day, having lost one-third of its weight; the third, having received one cubic centimeter of serum, died in 30 hours. In the first and third case the liver was very much congested and enlarged.

Although the intravenous injections differ from the accustomed mode of ingestion of food, M. Redon thinks it highly probable that the eating of the flesh of animals that have died from fatigue is detrimental to health. Acting on this presumption, the veterinary inspectors promptly quarantined all the animals of the consignment that showed signs of the fever of fatigue. (Revue Scientifique, June, 1895.)

Poisons of Putrid Fish.—In a short article, incorporated in the Bull. U. S. Fish Commission recently issued, Dr. J. Lawrence Hamilton points out the connection between foul fish and filth diseases. Beginning with cholera, he notes the outbreak of this disease in 1893, in the fishing ports of Grimsby and Hull, and instances cases of deaths which occurred from mussels, cockles and oysters from those infected ports.

It is well known that fishing populations, from their slovenly and dirty habits, are more prone to endemic as well as epidemic affections. The author refers to Astrakan, the seat of the sturgeon and caviare industries, as a case in point. Statistics show that the population of this place would become extinct were it not recruited from external sources. During the winter of 1878–79, the plague devasted the place, and the worst and most fatal cases were among the laborers employed in fish salting, who live under very miserable conditions. The price of bread being beyond their reach, they subsist chiefly on the leavings of the inferior parts of the prepared fish. Formerly, Government rules enforced that the unused remains of the prepared fish should be thrown directly into the the water, but now these, collected and accumulated in masses, are left to rot in and about the banks of the rivers under the heat of sometimes an almost tropical sun. The local atmosphere is further vitiated by many fat-boiling, fish-oil, isinglass, etc., works. During the five years preceding the outbreak of plague in 1878, enteric fevers, measles and small-pox were epidemic, whilst scarlet fever raged in 1876–77. Previous to 1878, the town of Astra-

kan, during 22 years, had suffered from nine epidemic attacks of cholera and three of enteric fever.

Such skin diseases as elephantiasis, ichthyosis, and beri-beri are suspected of being produced by a combination of fish, filth and poverty.

Wounds caused by the handling of decomposed fish are often very serious. The author gives a list of such cases. The Norwegian whalers take advantage of this fact by using prepared putrefactive poisoned harpoons. The whales are driven toward shore, surrounded by a net to prevent escape, and then struck with the poisoned harpoons. After twenty-four hours they show signs of exhaustion, probably through septic poisoning, and are readily captured. The harpoons are recovered and carefully preserved, without wiping, for future use.

The importance of the question of putrid food cannot be overestimated, hence the author's strong language in urging a better supervision of the fish-markets. Especially does he condemn the practices of leaving fish ungutted and unbled until sold, and of keeping fish soaked and sodden with water to make the skin look bright.

The foul condition of the boats, and of the boxes in which the fish are shipped to market, and the unsanitary condition of Billingsgate Market, are described in disgusting detail, and suggestions are given for, at least, mitigating these evils.

The infection of fish by impure preservatives, such as ice made from impure water and dirty salt and also bacterial infection, are referred to. In this connection the author remarks that "the cleanliness in the United States caviare factories is unknown in southern Russia, the home of astounding dirt and disease, augmented by the most hideous poverty and ignorance."

It has been supposed that prolonged soaking would render diseased animal food innocuous, but it would seem, from the experiments conducted by Prof. Pamem and again by Dr. Bremton that the vitality of poisons derived from putrid and other animal matter, though weakened, is not destroyed by boiling. Accordingly, to avoid all possible danger of the use of condemned food, the author recommends that it be burnt in properly-constructed local furnaces, and he includes, under this head, particularly "fish, its offal and refuse."

Another important suggestion as to public welfare is for all fish to be bled, gutted, cleaned, and dry-air-frozen at the place of capture. This would do away with many of the evils complained of, and is, moreover, a feasible business project. The author's investigations on this point warrant him in stating that "every day in the year, 2 pounds of bled, gutted, cleaned, dry-air-frozen (imperishable) fresh herring

(about 6 fish) could be profitably retailed by costermongers for one penny, or 2 pounds of sprats for one halfpenny."

A sharp arraignment of the "Billingsgate Ring," which Dr. Hamilton accuses of diminishing the market supply of fish, in order to keep up the price, by getting the fish destroyed at various places along the coast, and a brief description of the "koshering" process for preserving animal food, closes this interesting paper.

The idea embodied in the article is, that foul fish is one of the most unwholesome, disease-producing factors in existence, but the conditions that result in such food being put upon the market are not necessary, but are due to ignorance, carelessness and greed, and can be remedied at no great expense. (Bull. U. S. Fish Commission, Vol. XIII, pp. 311–334).

ENTOMOLOGY.[1]

The Genera of Lysiopetalidæ.—The genus Spirostrephon was founded by Brandt on *Iulus lactarius* Say, in 1840. Owing to the fact that many subsequent naturalists have not had an equally vivid appreciation of generic characters and limits, Spirostrephon has usually appeared as a synonym of Lysiopetalum, the typical species of which is *L. fœtidissimum* (Savi).

Through the kindness of Mr. Pocock of the British Museum I have had the opportunity of comparing specimens of *fœtidissimum* with abundant material of *lactarium* from Pennsylvania, Ohio, and the District of Columbia. The form, and ornamentation of the body and the location of the repugnatorial pores render the generic distinctness evident, as Brandt pointed out. Brandt also remarks[2] the similarity with Cambala, but holds the genera distinct because the ocelli of Cambala are represented as arranged in a single row. There seems to be no ground for Latzel's inference that Brandt included Cambala under Spirostrephon.[3] Brandt saw but one specimen, which must have been young, as the length and number of segments are less than in mature specimens of *lactarium*.

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

[2] Recueil, p. 90.

[3] Myr. Ost. Ung. Mon., II, p. 353.

The Lysiopetalidæ seem to be in need of careful generic revision. The result would probably be the recognition of several new genera from Europe and Western Asia. Recently Dr. C. Verhœff has attempted to arrange some of the European species[4], and with his usual disregard for the association of generic names with their typical species has placed *Lysiopetalum fœtidissimum* under a subgenus Silvestria, while other species unknown to Brandt form the basis of the subgenus Lysiopetalum, *sensu strictu*. The conjecture is offered by Dr. Verhœff that *Lysiopetalum carinatum* Brandt belongs in the latter subgenus, and if this is really the case there is no need of a new generic or subgeneric name. According to Berlese[5] *Callipus rissonius* Leach (1826) is a synonym of *Lysiopetalum carinatum* Brandt, but the earlier designation having priority, Dr. Verhœff's second subgenus seems to be entitled to a name seventy years old.

The late Mr. C. H. Bollman conjectured from the description of Callipus that it is the same as Lysiopetalum, and proceeded to form the names of the family and superfamily accordingly. Mr. Pocock has adopted this suggestion. However, it seems clear that we must identify a type species for Callipus, or it is a *nomen nudum*, and may be neglected; also, if we are to use the name Callipus we must accept Berlese's identification until reasons to the contrary are shown, and the meagre description of Callipus will make these hard to find. I have examined a specimen purporting to be *Lysiopetalum carinatum* Brandt and agreeing with the original description, as far as that goes. The differences between it and the specimens of *fœtidissimum* are very considerable and render it probable that the two genera may be maintained on sufficient characters when a careful study of the European forms has been made. In the meantime we may accept the three genera as distinct, and continue the use of the older name Lysiopetalidæ, which would need to be resumed in case it were at any time proven that *fœtissimum* represents a generic type distinct from *rissonius*, whatever that may be.

The genus Eurygyrus C. L. Koch may also prove to be distinct, and the enormous species *Platops xanthina* Newport evidently represents an independent generic type, if the analogy of other Diplopoda does not fail in the Lysiopetalidæ. The genus *Platops* Newport was founded, according to Pocock, on *Lysioptalum lactarium* Say, and so becomes a synonym of Spirostrephon. Two other genera, *Cylindrosoma* Gray

[4] Zool. Anzeiger, XVIII, p. 207.

[5] Studi Critici dei Chilognati, etc., Part I, Julidæ, p. 31.

and *Reasia* Gray, have been referred to the Lysiopetalidæ. As no species have been published under them and practically no descriptions are given, they may be looked upon as *nomina nuda*, and not included in the synonymy of any of the genera. The following, then, are the genera of Lysiopetalidæ which have not been properly disposed of, and may for the present be assumed to be valid:

Genus Callipus Leach (1826); type *rissonius* Leach; locality, Nice.
Syn. (Subg.) *Lysiopetalum* Verhœff; type *illyricum* Latzel.

Genus Lysiopetalum Brandt (1840); type *fœtidissimum* (Savi); locality, Italy.
Syn. (Subg.) *Sylvestria* Verhœff (1895); type *fœtidissimum* (Savi).

Genus Spirostrephon Brandt (1840); type *lactarium* (Say); locality, North America.
Syn. *Platops* Newport (1844); type *rugulosa* (Gray)=*lactarium* (Say).

Genus Eurygyrus C. L. Koch (1847); type *rufolinatus* C. L. Koch; locality, Constantinople.

Genus Megastrephon nov.; type *xanthinum* (Newport); locality, Asia Minor.—O. F. Cook.

Habits of Ants.—In an interesting paper on the ants of India[6] Mr. G. A. J. Rothney reports that the nest of a colony of *Myrmicaria fodiens* Jerdon, under a banyan tree in the park at Barrackpore which had been constantly under the author's notice between 1872 and 1886 was still flourishing in January, 1894, showing a continuous residence in one spot of twenty-two years. In Madras he found *Monomorium salomonis* Lin. used in protecting bales of paper from white ants. The paper merchant scattered sugar around the sides of the bales every day to ensure the attendance of these red ants.

Concerning *Pheidole rhombinoda* Mayr. Mr. Rothney says: "I found some nests in Barrackpore Park, covered over in a perfect circle (taking the centre from the entrance, the circumference would equal about 10 to 12 inches), with the leaflets of some species of mimosa, but no leaflets were found in the nest itself on digging it up, and the even and umbrella-like appearance of the arrangements seems to suggest a protection against heat or rain, as the objects the ants have in view.

"In Madura, I came across a number of nests of a very curious and, to me, novel form.

"The entrances were surrounded by little mounds arranged in a circle, composed of the dead bodies, or parts of bodies, of *Camponotus com-*

[6] Trans. Ent. Soc. London, 1895, Part II, pp. 195–211.

pressus and *C. rufoglaucus*, but chiefly the big soldiers of compressus. There were heads alone, heads with the thorax attached, thorax without the head, bodies without thorax, with a scattering of legs and antennæ, attached and unattached, in every possible form, but I could not find any of these portions in the nests. Now the question arises, What are these mounds for, and how does Pheidole collect and form them? Are they simply carcases stacked, to be cut up at leisure and carried into the nest in suitable sizes for future provision, or are these bodies arranged as a grim warning to prowling enemies, after the fashion of skulls set up at the entrance to the villages of some wild and primitive tribe? and, then, how does Pheidole collect them? It is hardly possible that they are killed and brought in, for Pheidole would have to be in overwhelming force to master a single giant-headed soldier of compressus. Perhaps they act as undertakers, and collect the dead thrown out by Camponotus for some special purpose of their own; and, then, why should this trait break out in Madura, for certainly I have not met with it in other parts, although compressus and rhombinoda are practically common everywhere."

Mr. Rothney was unsuccessful in getting ants to stridulate while on the march. He thinks they do so, however and concludes that "in laying down rules for ant conduct some allowance should always be made for the different little traits of character, the whims and fancies, as it were, which are to be found not only in a given species but in individual ants."

Entomological Notes.—Mr. R. I. Pocock figures and describes[7] an interesting stridulating organ in the male of the spider *Cambridgea antopodiana* (White). He believes it is used as a sexual call, no such organ being found in the female.

Professors J. H. Comstock and V. L. Kellogg have prepared an extremely valuable laboratory handbook entitled The Elements of Insect Anatomy. It is published by the Comstock Publishing Co., Ithaca, N. Y.

Bulletin 48 of the U. S. National Museum consists of a Revision of the Deltoid Moths by Prof. J. B. Smith. There are 126 pages of letterpress and fourteen plates of figures.

"A Preliminary List of the Hemiptera of Colorado" is the title of Bulletin 31 of the Colorado Agricultural Experiment Station. In it Messrs. Gillette and Baker have prepared a faunistic paper of unusual value. There are 647 species listed, belonging to 261 genera; five new genera and 111 new species are described.

[7] Annals & Mag. Nat. Hist., XVI, 230.

In Bulletin 33 of the U. S. Division of Entomology, Mr. L. O. Howard presents a valuable compilation concerning American Legislation Against Injurious Insects.

EMBRYOLOGY.[1]

Conjugation of the Brandling.—Of the many kinds of earthworms common in the Eastern United States one of the best known is the prettily colored but offensive-smelling species often called the striped worm from its conspicuous cross bands of red-brown and yellow, but known to the specialist at present as *Allolobophora fœtida*. It abounds in decaying vegetable matter especially in compost and manure heaps where it lies a few inches beneath the surface and may be readily captured though quick and active in its movements. In some regions it is regarded by the youthful angler as especially attractive bait for trout and as bait it has been used ever since the days of Isaac Walton who refers to it repeatedly in the Complete Angler by a name too characteristic to be lost from our vocabulary—the brandling. Thus in speaking of bait for the perch he says—"and of worms the dunghill worm called the brandling I take to be the best, being well scoured in moss or fennel."

It is well known that earthworms, though they are hermaphrodites yet interchange sexual products in a remarkable process of conjugation. Our knowledge of this process, is however, confined to the accounts of two naturalists who studied the large European earthworm *Lumbricus terrestris*. W. Hoffmeister, whose work on earthworms published in Brunswick in 1845 was the pioneer in a field that was later so diligently tilled by French and of late by English specialists, observed the worms as they came out on the surface of the ground in the night-time and obtained a pretty good idea of the main phenomena of conjugation.

His account is in the main as follows: "The old worms leave their holes first, the younger ones only when it is quite dark. They protrude their bodies with great caution and very slowly, after resting a while they feel about with the anterior end of the body till they reach a neighbors's hole or come upon another worm. They now crawl along

[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts, reviews and preliminary notes may be sent.

against and carefully examine one another. If the worm that is found is not mature or even if it is smaller than the seeker, greeting does not last long and the worm continues his search in some other direction till he succeeds in finding some other individual like himself . . . .

. . . . . He generally finds one waiting or else entices one from its hole by thrusting his head into it. They undulate against one another; now one now the other drawing back is always followed by his companion. The movements soon become more active; they strike one another with their heads.

At length they both lie still with the ventral surfaces near together. The body begins to undulate, especially at the girdle and within a few minutes the sucking action of the girdle comes into play to establish a more firm union of the two animals. The side parts of the girdle that bear the sucking disks are spread out in wing-like expansions while the ventral part is much drawn in. In this way a sort of tube is formed and in this the other individual is enclosed.

The mutual adjustment of one to the other becomes more and more close and accurate while the undulations of the transverse muscles and of the girdle constantly increase. Meanwhile mucous flows copiously from the dorsal pores and from the girdle. Usually a lot of young worms now assemble and greedily suck up the mucous.

The pair lie motionless for a good half hour before the seminal fluid could be seen flowing out . . . . . .

Once I watched for a pair the day after conjugation, in vain, but the following day I found one of the two in conjugation again. Conjugation seems to be repeated so often that one may imagine a separate fertilization for each egg.

In the above account all that refers to the actual transfer of sperm has been omitted as it contains many errors that have been corrected by our only reliable authority on this problem, Ewald Hering,[1] who in 1856 as a medical student in Leipzig made so careful a study of the reproductive organs of the earthworm that many years elapsed before his discoveries were rediscovered and introduced into text books in place of the erroneous views long lingering there.

His account of the conjugation of earthworms is all the knowledge we have of the process, at present, and is here translated in full to make intelligible the facts that we have to add in regard to conjugation in the brandling.

"When conjugating the worms lie in opposite directions with their ventral sides applied to one another. By drawing in the ventral side

[1] Zeit. f. wiss. Zool., VIII, 1856.

each hollows out the girdle and the neighboring rings into a boat-shaped depression. The other worm lies in this excavation. There is then a copious secretion of mucous that gradually hardens on the surface and encloses both worms is a common envelope. The union becomes closer and closer, especially so in the regions of the girdle and of the male openings.

The ventral elevations of the girdle always lie opposite to the 9th, 10th and 11th rings of the other worm while the ventral elevations about the male openings lie opposite to the 26th ring.

The elevations of the girdle begin to contract rhythmically. Anterior to the girdle the region between the upper and lower setæ on each side swells up as a longitudinal elevation bounded by two longitudinal grooves. As the worms lie on one side this can be seen only on the other, upturned side. This elevation forms gradually from behind forward as far as the 15th ring when it terminates in the glandular swelling about the male opening. In a live worm the position of the grooves bounding the above elevation is indicated by two more or less darkly pigmented parallel lines on each side from the 15th ring to the girdle (Hoffmeister erroneously regarded these as canals). When a worm is thrown into spirit it generally forms in its violent contractions both the longitudinal elevations and the boat-like excavation of the girdle.

Since the ventral surface is flattened out or even made concave during conjugation the ridges of both worms lie pretty close together and the lower or less essential furrow is concealed from observation. The upper furrow, however, is evident as a longitudinal groove along which we may see waves of muscular contraction passing from before backward. This contraction consists essentially in a change in the furrow and its rims. The rims draw together to form a pit in the 15th ring which then passes back to the girdle, like the trough of a wave. In one minute about fourteen such pits may be seen to form and pass back.

The ejection of sperm takes place only after an hour or more from the beginning of conjugation. We see a small drop ooze out of the slit in the elevation of the 15th ring and enter the longitudinal furrow where it looks like a white rod about as long as a ring is wide. This drop of sperm is taken up by the pit above described and led backward. When it has proceeded abouts its own length from the opening a new drop is poured out and so on. The ejection of sperm thus takes place with rhythmic interruptions and we see passing back in the furrow a row of small white rods separated by intervals equal to their own length. As the rods as well as the intervals between them just equal

the length of a ring, every other ring will have a drop of sperm in its furrow at any given moment. The sperm thus flows from the 15th ring to the girdle outside the animals, covered only by a layer of mucous. We may calculate the time taken as about 80″.

The girdle now becomes especially active. Its muscular elevations on the sides and at each end contract rhythmically about fifty-five times a minute to form shallow depressions which advance in a wave-like manner. The lateral depressions move downward and the end depressions toward the middle of the girdle ridge so that the sperm that has been poured out and accumulated between the worms under the girdle is concentrated, more and more, about the openings of the seminal receptacles, which lie opposite to the swollen part of the girdle. The same object is accomplished also by a second rhythmic motion that occurs about twice a minute; the lateral part of the girdle alternately presses against and lifts up from the other animal and so drives the sperm towards the openings of the seminal receptacles. There is no doubt that the sperm is taken into the seminal receptacles; their openings lie free under the mucous envelope and the sperm may be seen collecting about them. Perhaps the taking in is brought about by some sucking action of the receptacles. Though the ridge on the girdle continues to collect the sperm about the openings it cannot press it in as it does not cover them. G. Meissner mentioned accessory organs concerned in introducing sperm and eggs into these narrow openings, but as yet I have found none.

When the ejection of sperm is finished the longitudinal swelling and furrow slowly disappear in the direction opposite to that in which they appeared. The contractions of the girdle yet continue for some time till the sperm has so far disappeared that only a small drop remains about each opening of the seminal receptacles. When the conjugation has taken a normal course these white drops are found on both worms and on both sides of each. I often examined them microscopically and never found any eggs though they probably would have been present if, as Meissner supposed, they are taken into the receptacles along with the sperm.

At length the worms separate from one another by a powerful wrench for which the tail ends that still remain in the ground serve as points of resistance. If we cut off both tails at once the worms often remain united for hours. If thrown into spirit they die without separating.

The entire act of conjugation lasts two to three hours and may be easily observed under the lens since the worms are shy only in the early stages while when an intimate union has taken place we may use a brilliant light and even lightly touch without disturbing them.

PLATE XXXIII.

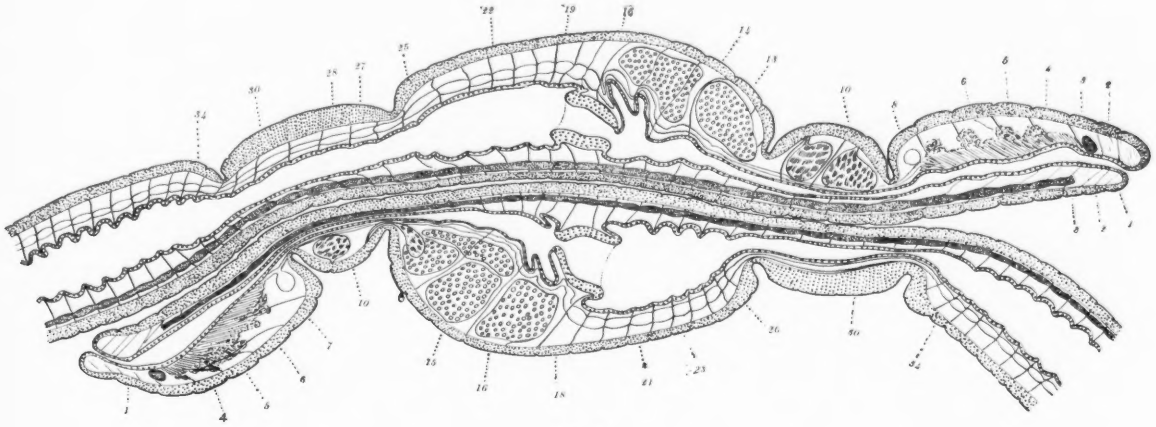


FIG. 2.

Andrews on Allolobophora.

PLATE XXXIV.

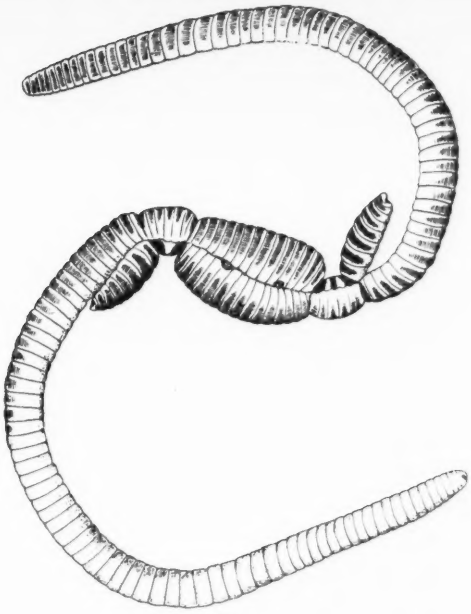


FIG. 1.

FIG. 4.

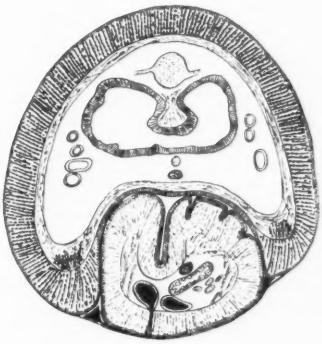


FIG. 5

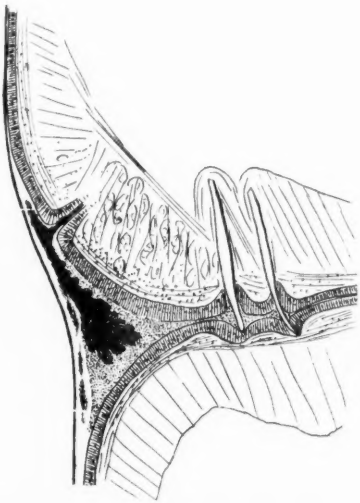


FIG. 6.

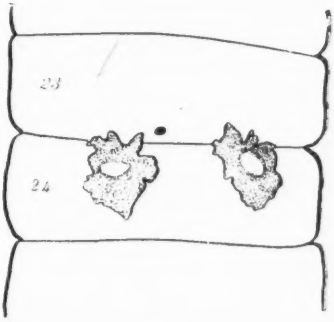


FIG. 3.

Andrews on Allolobophora.

The formation of the grooves and the ejection of sperm do not always take place simultaneously in both worms. They may also be of considerably different dimensions and yet accomplish conjugation since they are so changable in form. As a rule, however, both worms act in every respect alike.

As it seems scarcely credible that the sperm should not spread out on the moist surface of the body one might at first suppose that it flowed back in a canal covered only by the transparent epidermis, yet no such canal is to be found nor any opening at the girdle. Moreover the seminal ducts open directly to the exterior and in handling a long worm, I once saw issue a white drop of what proved under the microscope to be sperm.

After conjugation a small flat, club-shaped process is found on each side of the worms. This so-called penis is about 1‴ long and is generally in the region of the 26th ring, seldom at the girdle. It generally lies in the region of the ventral setæ, sometimes on and sometimes between rings. It is sometimes duplicated and sometimes absent upon one or both sides. It gradually becomes harder though at first soft; it is a hyaline mass with a droplet of sperm imbedded in its free end. In my opinion it is made of hardened mucous. Before conjugation it is absent; if we separate conjugating worms before ejaculation it is soft and contains no sperm; it is demonstrably a product of conjugation. When formed in the region of the 26th ring opposite the male opening it receives sperm from the other individual and in the few cases in which it is on the girdle it receives sperm from the worm on which it is found. In the exceptional cases in which it lies on other regions of the body it contains no sperm.

It seems superfluous to describe all the varieties of form, number and position of such an unessential structure."

Many features of the above remarkable interchange of sperm may be readily observed in wet nights in the Spring and Autumn in the public parks of Baltimore where this large earthworm, *Lumbricus terrestris* has been introduced.

In the case of the smaller brandling, direct observation is precluded by the fact that the worms do not come to the surface to conjugate but lie closely appressed and bent some inches beneath the surface of the wet dung heaps they abound in. When disturbed they slowly separate. The following facts relative to their conjugation are hence confined to observations upon preserved material.

At Byrn Mawr, Penn. in May, 1892 and in Baltimore in May, 1895 attempts were made to harden the worm in pairs by the use of Perenyi's

liquid, picric acid, chromic acid and Merkel's liquid but the worms separated in hardening; it was found, however, that when thrown into hot corrosive sublimate or even into boiling water the animals remain in a very natural position. This is due to the fact they are enveloped, especially in the region of the girdle, by a secretion that is coagulated by heat while the worms themselves are so quickly killed that they do not contract enough to change shape or to tear themselves apart. It is thus possible to obtain preserved pairs such as indicated in figure 11 that very accurately indicate the appearance of the conjugating worms when alive.

Even the large Lumbricus may be well preserved in pairs by plunging into actively boiling water and then hardening in alcohol.

From figure 11 it will be seen that a pair of conjugating brandlings lie in a somewhat S shaped figure with the heads in opposite directions and the ventral sides turned toward one another anteriorly though posteriorly each may have it ventral side in the normal position, downward. Each may twist so that its anterior part lies on the side, the right or left in both worms. It is noticeable that at two regions the worms appear constricted as if threads had been drawn about them but in reality it is only the firm envelope of mucous which binds them together. These two regions are separated by a long expanded region on the side of which may be seen the swelling about the male opening. Each constricted region is made up by the light colored girdle on one worm and the small dark colored region near the head of the other, a region of three rings that we will find subsequently are nearly enclosed by the girdle. The most anterior part of each worm may be free and is then immediately followed by the short region so very firmly clasped by and attached to the girdle. This free tip of the body contains seven rings in each worm. The following part that fits into the girdle contain three or four rings. The expanded region between this and the following girdle contains fifteen or sixteen rings and the girdle itself six or seven. Posterior to the girdle the animals may be nearly or quite free from one another so that the extend of the closely united region when the seven anterior rings are free, may be only twenty-four to twenty-seven rings of the entire one hundred, approximately, that make up the worm. The applied areas do not fit together exactly ring to ring and though they begin and end at the same distance from the head in each worm a fixed point, such as the male openings in the fifteenth ring, is not exactly opposite the same ring in each case. Approximately the male opening on the fifteenth ring of one is opposite the twenty-first ring of the other worm whereas we would expect it to be diagrammetically

opposite the twenty-fifth if the seventh ring of one is opposite the thirty-third of the other.

(*To be continued.*)

PSYCHOLOGY.[1]

Recent Work in Hypnotism.—With the June number the "Revue de l'Hypnotisme" completed its ninth volume and in turning over its pages I find several articles that are of more than merely technical interest.

Liébeault of Nancy contributes two articles on the psychology of normal sleep and its relations to hypnotic sleep and waking life. The essential characteristic of waking life is the activity of attention and will; in sleep both faculties become quiescent; in hypnosis we find an anomalous "polarisation" of attention, it being riveted on the idea of sleep on the one hand, whereby actual sleep is induced, and on the personality of the hypnotizer on the other. Will is quiescent, and thus the patient becomes amenable to suggestion. Violent passions, "fascination," aboulia, and all other states in which will power is weakened, are to be regarded as akin to sleep.

Prof. Matias-Duval outlines a histological theory of sleep suggested by the Golgi-Cajal doctrines. Admitting that the ultimate nervous elements are functionally related, not by actual physical continuity, but by mere contiguity, it is natural to suppose that the transmission of nervous activity would be facilitated by approximation of the terminal filaments. It is not improbable that they may be capable of amœba-like extension such as has been observed by Wiedersheim in the brain of *Leptodora hyalina*. It is possible that a paralysis of these terminal filaments may be brought about by the absence of oxygen and excess of carbonic acid; the transmission of nervous activity would thus be impeded and sleep supervene.

Dr. Raphael Dubois contributes a paper on the physiological conditions of hibernation in the marmot. He has been unable to find traces in the blood of the hibernating animals of toxalbumens, toxines or other somniferous agents, but has found an excess of carbonic acid which he ascribes in part to the depression of circulation, respiration

[1] This department is edited by Dr. Wm. Romaine Newbold, University of Pennsylvania.

and temperature, but chiefly to a dehydration of the blood. A portion of this water accumulates in fluid form in the stomach and caecum, and another portion in the peritoneum and other membranes in the form of lymph containing leucocytes. At the same time, owing to a diminution in the portal circulation, glycogen accumulates in the liver. Upon awaking, these fluids are reabsorbed, the leucocytes convert the glycogen into sugar and the temperature rises. All these phenomena are under the control of the center for thermic sensibility in the anterior portion of the aqueduct of Silvius; and between this center and the polar plexus, which controls the portal circulation, there is direct anatomical relation. Acetone, which is known to have soporific powers, is also found in the blood of the hibernating marmot and doubtless contributes to the total effect. "The winter sleep of the marmot may therefore be described as a carbonico-acetonemic autonarcosis."

The doctrine of the subconscious fixed idea has never been as clearly and succinctly stated as by Pierre Janet in the June number of the *Revue*. He gives first a typical case of a conscious fixed idea. A woman, aged 33, of neurotic ancestry and hysterical antecedents, fell at sight violently in love with a physician called to attend her child, and for some years remained under the control of this fixed idea. Here we have (1) Marks of mental weakness, (2) An irrational passion attached to one idea, (3) Its natural consequences in words, acts, etc. Four other cases are then detailed, precisely analogous, save in the absence of the second factor, there being no conscious fixed idea. A hysterical woman, aged 21, has repeated attacks of vertigo and of groundless terror. Another sustained, at 29, three great shocks: her father lost his money, a near friend died of phthisis in her presence, and she saw a man crushed to death. For four years afterwards she fell into an apparently dreamless sleep upon the least shock. A girl aged 16 has nocturnal micturition, but affirms that she never dreams. A woman of neurotic family, a brother being hysterical, a sister insane, father and grandfather drunkards, has monthly attacks of mental and physical distress which end in an uncontrollable desire to drink. After a spree of several days' duration, she recovers consciousness and has no memory of the attack. While her normal self she is a total abstainer, and has a horror of the liquor which has ruined her family. In all these cases we have no conscious fixed idea. But when hypnotized, it apparently comes to light. Case (1) in hypnosis tells of a horrible dream she once had, in which she jumped from a bridge; this dream recurring produces the vertigo. When a child, she was frightened by a snake, and she claims that her terrors are due to seeing snakes about

her. Case (2) is told, while hypnotized, that when she falls asleep she is to dream aloud; her dreams are invariably repetitions of her friend's death-scene. Case (4) confesses to an insane desire to drink, of which her normal self is wholly unconscious, and Janet, upon tracing the history of the case, ascribes this to the fact that in her earlier convulsive attacks, the suggestion to drink was constantly given her by the presence of her drunken father. Case (3) hypnotized, has no memory of dreams which could cause her annoying trouble, but her hand, in automatic writing, tells of nightmares utterly unknown to her, during which micturition takes place. From these cases Janet draws the inference that in all a fixed idea exists subconsciously, producing in the upper consciousness effects analogous to those produced in the first case by a conscious fixed idea.

Prof. Pitres reports a case presenting analogous features. L. G., aged 37, became subject to hysterical convulsions in consequence of a runaway accident in which she and her child were thrown from a cart. The recurrence of this experience in the form of a dream or nightmare was the basis of her crisis. By hypnotic suggestion Prof. Pitres abolished its more terrifying features and diminished the violence of her attacks, but was unable to affect her sensory symptoms, pains, etc. While experimenting with another end in view, he made her dream that a certain surgeon performed an operation upon her; next day upon seeing the surgeon she had a, to her, inexplicable feeling of aversion for him, and, at the same time, felt a pain in the part upon which the imaginary operation had been performed. It would seem that the sight of the surgeon awakened into subconscious life the dream and its consequences. Acting on this hint, Prof. Pitres suggested dreams in which sundry doctors cured her pains, and so obtained results which he could not get by direct suggestion.

From the medico-legal point of view, the possibility of criminal suggestion is discussed by Prof. Delboeuf, of Leyden, and Dr. Liébeault, of Nancy. Prof. Delboeuf recants at length the affirmative view which he has expressed in his earlier works. Laboratory experiments are worthless; the patient is always more or less influenced by the suggestions of the environment as well as by the command of the hypnotizer, and is consequently fully aware that the whole performance is a mere comedy. We are all subject to criminal auto-suggestions in our dreams, and we know how little mischief actually results from them; the danger from hypnotic suggestions is no greater; it will never be as great as that of evil communications and corrupt example. Yet

Prof. Delboeuf admits that signatures to wills, etc., may be secured and attempts on chastity made easier by hypnotic suggestion.

Dr. Liébeault's articles in reply adduce no new arguments and wholly fail to meet the points raised by Delboeuf. He merely emphasizes the power of suggestion and the helplessness of the subject. The single case which he quotes as conclusive is of no value. Dr. X. and himself successfully suggested theft to a working man; some years later he was convicted of numerous petty thefts and imprisoned. After his release he told Dr. Liébeault, while hypnotized, that his second series of thefts had been committed in obedience to a second suggestion from Dr. X. The total lack of evidence for the man's previous honesty and of confirmation of his story, taken in conjunction with Liébeault's obvious predisposition to accept this view of the case, robs it of the interest it would otherwise have had.

Two cases of death in the hypnotic state are reported. One was a patient of Bernheim's; the autopsy showed that death was due to a pulmonary embolism with which the hypnosis could have had nothing to do. The other is the sensational case in Hungary of which a brief account appeared at the time in the American papers. Frl. Elsa Solomon, living in the neighborhood of Buda-Pesth, had suffered from hysterical attacks for several years, but had found considerable relief during the last 18 months of her life in hypnotic treatment at the hands of her physician. A man named Neukomm, described as a "specialist in well-digging," happened to be visiting at her father's house and hypnotized her for experimental purposes. She was found to be possessed of clairvoyant powers. On Sept. 17, 1894, Neukomm hypnotized her, much against her will, as she was feeling badly, and told her to visit in spirit his brother, ill at Werschetz, and describe his condition. This she professed to do. He then asked what would be the outcome of the illness. She replied, with difficulty, "Prepare for the worst," and immediately fell from her chair with a cry. Her heart was still beating, and an injection of ether was given, but she died in a few seconds. A medico-judicial commission appointed by the Government reported that her death was due to cerebral anaemia, and refused to inculpate Neukomm. As he continued experimenting, the Hungarian Government issued an edict restricting the practice of hypnotism to regular physicians, and requiring that the patient in every case sign an order, before witnesses, asking to be hypnotized. The hypnotization must also be in presence of witnesses.

Casimir de Krauz contributes six admirably impartial articles upon the experiments conducted by Dr. Ochorowicz and others with Eusapia

Palladino in Warsaw. He has given in concise form and a civilized tongue the gist of the discussion which raged about the case in the Polish magazines and newspapers. Lack of space prevents my giving any extended account of these remarkable experiments at present.

Dr. Quintard, of Angers, reports the case of a child of six who appears able to read his mother's thoughts. The case seems to deserve careful investigation.

As usual, the *Revue* abounds with accounts of remarkable cures wrought by suggestion, but the most interesting of the articles from the therapeutic point of view is one on "The Clinical Indications of Hypnotism," based upon Prof. Morselli's sixteen years' experience. Prof. Morselli belongs to the school of Braid, Richet, and Bernheim; he has found about one-fifth of his patients hypnotizable, neurasthenics, hysterics and maniacs being the most refractory. He has never observed clairvoyance, telepathy, cerebral polarization, etc., and holds a negative attitude with reference to their possibility. He does not believe that hypnosis has dangerous results; is not oversanguine as to its therapeutic value, but has had good results in functional neuroses and in dealing with symptoms of organic disorders. The effects of hypnotic treatment he has found neither constant nor durable, and thinks it must be supplemented by other agencies.

The Cebus and the Matches.—A *Cebus apella* in the Philadelphia Zoological Garden has become an expert in striking matches. He distinguishes the end with the fulminate, and I have not seen him make an error in this point. He seizes the match at the proper distance from the fulminate and so avoids breakage. He uses for friction the rough side of a kettle which is used for water, and spends no time on the glazed surface. As soon as the match is lit he throws it away, and I have not seen him burn himself. No man could handle the match more appropriately. He does not however always select a a proper surface, as he tried on one occasion to strike a match on my finger, without success.—E. D. Cope.

Sand Swallows and Sawdust.—Mr. C. O. Thurston writes to the Naturalist, that during a visit at Groton, Conn, he observed sand swallows in great numbers building their nests in a large pile of sawdust instead of their usual resort, a sand bank.

ANTHROPOLOGY.[1]

The Discovery of Aboriginal Netting Rope and Wood Implements in a Mud Deposit in Western Florida.—I was in Florida, last April, tarpon fishing, and had been drawn down in the course of this pursuit to the neighborhood of the settlement of Marco—a few frame houses on the south-east coast, collected near the pass of the same name through the reef. This pass is an important one, as importance goes in this thinly-peopled region, it being a road to the safe shelter in Marco Bay, and also to the little wooden pier in Collier's Creek, leading from Mr. Collier's store and house. And Marco has clearly, for very many years, been thus important. A Spanish settlement was remembered by a friend of the "oldest inhabitant," and, from the more distant past, numerous kitchen middens, formed chiefly of shell-heaps, bring us heavy conch axes or clubs sharpened at the point and bored for handles, smaller conch and other shell implements, bits of black pottery, shell sinkers, and various ornaments, all presumably relics of the mysterious Mound-Builders. Hard cement-like floors of former huts or cottages are reported to be visible in the locality—Collier's is, in fact, built on Mound-Builders' débris, and the rows of these shell-heaps show the extent of their occupation of the place, both in time and numbers. Yet, withal, there has been hitherto a complete absence of wooden articles or of any textile fabrics from the discovered remains.

Here and there shell-heaps form the banks of what are locally called "muck" tracts, former creeks or inlents, now filled with peaty mud, ill-smelling when first disturbed. The drier of these have been for years overgrown with trees and bushes, some of which trees are old and dead. This peat muck is valuable as a fertilizer, and it is this property that originally brought the special basin, that I shall describe later on, particularly under notice.

I had been looking with curious eyes at a somewhat similar formation in the neighborhood of Naples City, a Floridian watering place, of from ten to fifty inhabitants, according to the season of the year, where we had been staying at its comfortable little hotel. At Naples there is an ancient waterway now in various stages of peat muck and stagnant pool—an artificial canal, cut with the clearly deliberate purpose of forming a canoe or boat pass from the sea to the lagoon or bay.

[1] The department is edited by Henry C. Mercer, University of Penna, Phila.

PLATE XXXV.

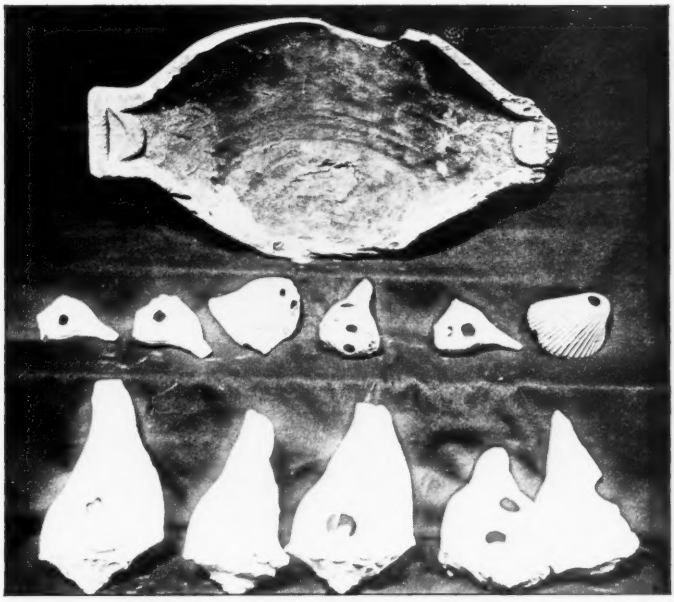


FIG. 1.

Aboriginal wooden trencher and perforated shells discovered by Lieutenant Colonel C. D. Durnford in a mud deposit near Marco, Southwestern Florida, in April, 1895.

PLATE XXXVI.

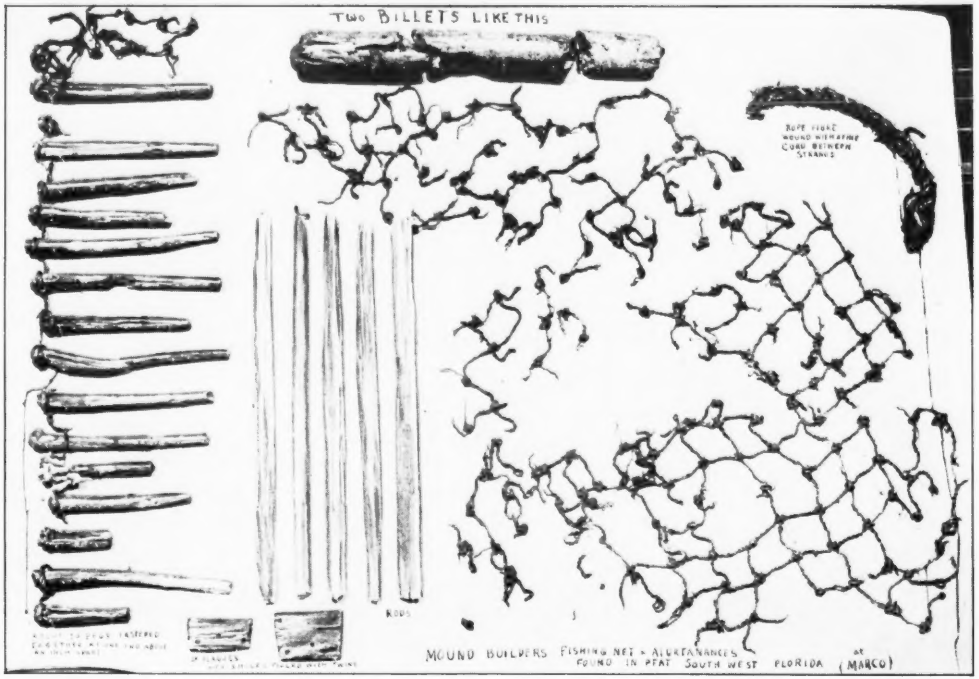

TWO BILLETS LIKE THIS
ROPE MADE WITH FINE CORD BETWEEN STRANDS
MOUND BUILDERS FISHING NET & APPURTENANCES FOUND IN PEAT SOUTH WEST FLORIDA at (MARCO)

FIG. 12.

Aboriginal rope fish net and appurtenances discovered by Lieutenant Colonel C. D. Dunford, in a mud deposit near Marco, Southwestern Florida, in April, 1895.

It is cut large and well for a distance of considerably over half a mile, and is an undertaking so extensive that it would have been looked upon as unreasonable to have credited the Mound-Builders with it, were it not that there exist similar and longer canals formed, I believe indisputedly, by these prehistoric people from their mounds to some of the larger watercourses in the neighborhood of the Everglades.

The preservative properties of peat at home, and the family likeness of this peat muck to the British article in its moister and more boggy condition, made me very loth to forego an effort to find out the secrets that I felt sure must be hidden at the bottom of the canal, and of its adjacent peat basins. It was, however, far too extensive and difficult a work to attempt under the circumstances, although various means of doing so had been canvassed with the other guests of the hotel.

Archæological instinct having been aroused, an amateur exploring expedition was accomplished to a curious cement-capped mound in the neighborhood, of which more anon.

Mr. Charles Wilkins, of Rochester, N. Y., left me still at work at this mound on the second morning, and went on to Marco in the hopes of coming across tarpon there. Two days later he returned to Naples, having made a find in a muck basin at Marco that excited our interest greatly. The results of this find it will, perhaps, be out of place for me to describe in detail here; suffice it to say that the articles consisted of wooden cups, a carved head of an animal, conch cups and conch clubs, with remains of their handles, and other most interesting articles of wood, pottery and bone. He had been led into this search, I believe, by a casual find of some kindred objects by one of Mr. Collier's people when getting "muck" for fertilizing purposes. One of the wooden articles had remains of fire still on it, and the black rubbed off upon the fingers as if it had been charred yesterday, although it must have been done before 2 feet 6 inches of deposit had formed over it, and a tree, a foot across, had grown and died above the old fire-site.

I at once made preparations for going to Marco to try and add further to this treasure-trove, and a few days afterwards my wife and myself were off with a boatman for the long row south, within the reef, through bay and canal with a strong tide which turns for or against at the most odd places and times, seemingly without reason, until one learns the ways of this strange reason, and that all depends upon which of the passes intersecting the outer reef, the particular canal or bayou is ebbing or flowing through. A small bayou between two passes will have the ebb tide running out of both its north and south channels at

the same time. Through miles of narrow waterways we row or are rowed, waterways bordered by the green mangroves with oysters hanging from their boughs, oysters grating against the boat's bottom here and there as the low tide made it difficult to pass through the canals cut in the oyster bars between the different lagoons, bays, reaches, bayous, lakes, channels, creeks, rivers, passes, as the lanes and sheets of brackish and salt water are variously termed, according to their special size and nature.

On our way we stayed for a few minutes at the rookery, an island teeming with sea-birds and their nests. The latter were close together on the mangroves, under which we rowed, for it was high tide and the roots were covered with salt water. We took some young cranes and pelicans out of their nests and returned them ungrudgingly thereto after they had bitten our fingers. So also I returned one of two eggs, the inhabitant of which, a juvenile pelican, was in a sufficiently advanced stage of composition to squawk reproachfully at being shaken.

We arrived at Collier's, Marco, at sunset, and the sandflies and mosquitoes being in full charge, I did not examine the muck-bed until next morning, when, with the aid of a "smudge," the smoke of which was less objectionable than the sandflies, and a hat-net for the mosquitoes, we proceeded to work. The basin is an oval about 150 feet long and 120 feet across (I write from memory), filled with peat muck, the bottom a hard shell bed that the sounding-wire, when pushed through the soil, struck each time in regular grade, giving, as far as I could tell from the cursory trials that I made, an even saucer-like pool, formerly filled with water, now with the peat muck deposits of centuries of disuse, the flat surface of which is covered with grass and trees, young and old, alive and dead. It is situated about 200 yards up from Collier's on the same bank of the creek, *i. e.*, the right bank. All the way up the creek rows of old oyster-shell banks or mounds are met with at right angles to the creek and to the road by the creek side. They have narrow openings, over which, at high tide there is, in one or two cases, still a trickle of water. At other times the road is dry over what used to be old canals or small side creeks, in which the canoes lay when the old world people sorted their drafts of fishes, opened their oysters or cooked their fish or game.

That these operations were habitually carried out here there is too much evidence to doubt.

On the morning after our arrival, I obtained the services of two of Mr. Collier's employés to dig in the peat basin. The pits already made by Mr. Wilkins were half filled with water, which percolates into all

of them a few hours after they are dug out. They average in size about 4 feet 6 inches in length and 2 feet 6 inches to 3 feet in width and depth.

I decided to dig in the direction of the shore, that is, between the last pit opened—from which we removed the water—and the nearest exposed shell-bank, perhaps 20 feet away.

Hardly had two barrow-loads of the earth been taken out when the finding and excitement, on my part, at least, began. One after another they came, the first of importance being a wooden tray or trencher, the rounded feel of which at first made us believe that we had found a canoe, two spikes of a fish, etc.

The trencher (See Plate XXXV) (which, with other of the articles found, is now in the British Museum) is of wood, in shape oval, with ends extended, squared and notched to form handles for the fingers to grip more readily. It is hollowed out and was well made. Underneath it is flattened, so that placed on a level surface it is capable of being rocked lengthways only. It is in a good state of preservation. Its length is 19 inches by 11 inches broad and 4 inches deep; in thickness it varies from $\frac{3}{8}$ to $\frac{3}{4}$ of an inch.

One of the next articles that we came upon, also, I believe, unique, was a curious funnel made of a clam-shell; it is shown in the accompanying photograph (See Plate XXXV). It had a hole, about $\frac{3}{8}$ of an inch in diameter, cut through its deepest portion, and there were signs of some brown fluid having been poured through it. Small pieces of black pottery and a small conch or two pierced for handles and sharpened, were also discovered; but the most curious of these old remains was the fishing-net which lay close to the trencher and to the other articles. It was well and evenly made, of about a 2-inch mesh, netted with a two-strand cord, the strands being spun from some vegetable fiber, perhaps cocanut or banana bark. Of this net, (See Plate XXXVI) a specimen of which has been deposited at the Museum of Archæology of the University of Pennsylvania, only a small portion was obtained, and that, unfortunately, in a very rotten condition, but a small piece of rope, an inch in diameter, of a coarser fibre, the division between its strands being interwound with a fine cord, and a number of interesting wooden appurtenances of the net were also discovered. (See Plate XXXVI). These consisted of five wooden sticks about 20 in. x 1 in. of irregular section, apparently made of the central palm-leaf stem, heavy and strong; their use is difficult to determine. There is no apparent mark of cords having been used in connection with them. There were also about thirty pins, made of an

exceedingly light, tapering, reedy wood, each about 9½ inches long by 1 inch in diameter at their thickest end. They were fastened together at one end—the thickest—at intervals of an inch, by a strong cord about $\frac{3}{16}$ of an inch in diameter. Each pin had a hole bored in it and a groove cut round the head to receive the cord, which, passing through the hole, was knotted after one turn and a half round the groove. There are also two small plaques of thin wood about ¼ of an inch thick, quadrilateral in shape, the sides measuring severally 3⅜ inches, 2⅜ inches, 3 inches and 2⅜ inches, the short equal sides making with the longest equal interior angles. Of one of these plaques only half was found, but they are evidently the same in design. The complete one contained five holes about ¼ inch in diameter; the three holes in the incomplete one corresponded in position with the three in the same part of the complete. The holes contain remains of cord which evidently had run freely through them. (See Plate XXXVI).

Two round wooden billets, about 17 x 3 inches, and one irregular block, about 5 or 6 inches across in its thickest portion, completed the appurtenances which seemingly form some kind of trapping arrangement to the net. Everything was found resting on the shell bottom of the "basin," and all nearly together. It seems to point to some sudden desertion of the spot, whether from fear or for some hurried foraging expedition or other reason. From whatever cause the place was left, the party did not return, though certainly intending to do so, as witness the beauty of the cup conches found by Mr. Wilkins, and the value of the nets and wooden articles, the condition of which, when found, points to their having been left there in excellent order.

The net was certainly placed where it lay by man, for the five loose sticks which served some unknown purpose were on the top of the bunch of the thirty or so smaller pins, and lying as if placed there by one hand hold. These smaller pins were piled in uncertain rows as to number and position, all seemingly tied together and at one end only. The idea that the whole position gave, was the arrival home of a fishing canoe, the net with its appurtenances being taken out, the heavier round billets (purpose unknown) first laid on the beach with the block between or next them, the trapping arrangements of thirty pins placed on the billets with the five sticks loose over the whole. The two small plaques, probably part of the trapping arrangement also, were a short distance above the main heap.

The net was placed joining the trapping-pins, but lower down the beach, and the rope lower still, near them being the necklace of fish fin-bones in a cup. Unfortunately, one of my assistants working in

the pit which I had cleared of water, broke through into the next one, just as the rope was discovered, and the water poured in and flooded both the one that had been freed, and the one that had just been opened, and not being then sure of the nature of my find, I gave up and left off at that point. I caused several other pits to be dug, but with little result.

As I could learn of no similar ancient articles having been discovered in this region, and as their nature, position and surroundings pointed to the probability of their having belonged to some uncivilized race who had inhabited this spot centuries ago, I preserved them as well as I could, keeping them wet until I was able to show them to experts. At the University of Pennsylvania I was fortunate in meeting not only Mr. Stewart Culin,[1] but also Mr. Frank Hamilton Cushing,[2] from whom I learnt the antiquity of these relics and the archæological value of the discovery. Mr. Cushing, whose experience and knowledge of these subjects is probably without parallel, considers them to be of pre-Columbian origin, and as, under the direction of Dr. William Pepper, Mr. Cushing is, I hear, to undertake a further exploration, we will, I hope, before long, be in possession of fuller information concerning the race who made use of them.

I mentioned, in the earlier portion of this account, a curious cement-capped mound which was partially examined by some of the tarpon fishers at Naples. The mound had been for some time the subject of discussion of the guides and hunters, and had created no small curiosity in the mind of at least one of the guests at the hotel.

This, as related by them, was the largest of three sandhills near Sandhill Bay (lagoon), not far from little Marco. The hills (I write from memory) are about a hundred yards apart, and joined by low ridges in a slight curve. The story of the guides was roughly as follows:

The mound was the most easterly of the three, and was about 30 feet above the sea level, perhaps the highest land between Naples and Cape Sable, a distance of 50 miles, excepting one—Caximbas Mound, the summit of which may be 40 feet above the sea. It lies about ten or twelve miles from Naples and five or six from Marco, and having water on two sides at a distance from its centre of about 70 or 80 yards on one side, and, perhaps, 100 yards on the other. It had been opened

[1] Director of the Dept. of Archeology and Paleontology of the University of Pennsylvania.

[2] Ethnologist Smithsonian Institute, Bureau of American Ethnology, Washington, D. C.

about two years before; first by two of the local hunters and guides, including one of the Weeks brothers, who came afterwards with our party, and again by one of the guides named Walker, who was also with us. These told the same story, viz.: that it was covered in by a regular "bottle" top of cement—hard stone cement—smoothed and even on the inside at the point where the men had got through, which they had accomplished at the summit. They found one skeleton which was described as lying about 4 feet below the cement. The cement was said to be more than a foot thick, and so hard that they could only cut just enough away to allow the passage of a man. Below it was a soft, fine, dry sand. They soon had to stop digging when they began piling up this sand on the edge of the hole, as it came falling in again. They did not get more than 4 or 5 feet below the cement, and found nothing but this fine, soft sand; in some parts it was "just the color of dripping blood, so red, not ordinary sand red, but as if it had been painted red, just like dripping blood," so said Bill Weeks, one of the hunters. They were looking for treasure, of course. This cement work and the blood-red sand being quite out of the common, Dr. Durrett, of Louisville, Ky., and myself, with a party of boatmen and hunters, therefore set out one morning, prepared to cut more deeply into this mound, and did so. We did not, by any means, fully explore it, but we cut into and across the "cement" dome, and found the guides' account to be practically correct. The dome is composed of a gray-colored close-binding mud. The blood-red sand or powder we did not come upon, but it is quite possible that that found by the hunters was some of the same hematite found by Professor Othniel Marsh in the Taylor Mound near Newark, Ohio, and which he supposed to have been used as paint. A description of this will be found in the *American Journal of Science and Arts*, Vol. XLII, July, 1866.

The remains of the hunters' former dig for treasure lay about the mouth of the small man-hole made by them through the cement, and in clearing away these and the shrubs near, we came upon several of the old and whitened bones that had been thrown out at that time, including half an arm bone that had been splintered, apparently, by some sharp weapon. Later on, the other half of the same bone, the fractures fitting perfectly, was produced, yellow from the sand below where it had been sheltered by the cement from all rain, except the direct fall into the small man-hole.

I am writing this description of our partial examination of this mound, solely on account of the curious, and, I believe, unique, rude dome formed over, so far as we know at present, one skeleton buried in

soft sand. We found therein no relics except these bones, which were in good preservation. The base of the cement dome rests on a ring of shells—chiefly oyster shells—evidently placed there to receive it, about 60 feet in circumference, 6 inches deep, and 18 inches across. The ring was laid upon sand. Rather above the level of this ring and in the centre, had been placed the body, and apparently over this had been made a rounded hill of fine sand, and again over this had been plastered the layer of light slate-gray mud, which, whatever had been the intention of the depositors, now remains as a waterproof, solid, self-supporting dome, about 15 to 18 inches thick, and 20 feet or so across, and perhaps 5 or 6 feet high. It defied a spade or ordinary hoe, requiring a grubbing-hoe and, in places, a crow-bar to pierce it.

On my return the second day in company with Mr. Wilkins, who remained a short time—Mr. Durrett, who had camped near the spot, having left earlier in the morning after completing the cutting across through the north side—I laid bare the whole inner base of one side of the dome; the sole result was the verification of the fact that the dome was evenly formed interiorly, and rested on the evenly formed shell-ring.

I am personally of opinion that the hardening quality of this slate mud was understood and deliberately utilized by these people. Floors of prehistoric huts and other buildings are said to exist in the neighborhood, formed of the same material, and a piece of the cement carried away by myself has hardened perceptibly since its exposure to the air. It is difficult to conceive of an observant people, who were also capable of making very fair pottery, not knowing or noticing this property of a material used by themselves in such a position. It has, however, been suggested, and, though not agreeing with the suggestion, I give it as a possibility, that the cement-forming capabilities of this gray mud were not understood by the builders, and that it was not intentionally employed to this end, but was simply mud from the nearest lagoon, placed over the sand-heap to prevent the sand from blowing away, and laying bare the remains. This hypothesis is based upon the uneven quality of the cement cover—that next the northern lagoon being softer and coarser than that next the south. Further enlightenment will probably be thrown upon this question also by the expedition which Dr. William Pepper is sending to Florida in the coming autumn.

—C. D. Durnford.

SCIENTIFIC NEWS.

Louis Pasteur was born at Dôle in the Jura region on Dec. 27, 1822. His father, a journeyman tanner, was poor, but he was a soldier who had been decorated for his valor on the field, and it is supposed that from him the famous man of science imbibed the patriotism which has always been one of his striking characteristics. His father superintended personally his early education, and the boy was sent to school at Arbois and began his classical studies there. It is said that in those days his devotion to study was not great. He was fond then of drawing, and preferred sketching his neighbors to spending time over his books, and this inclination seemed so strong that it was predicted he would ultimately become an artist. But the capacity for work which developed so strongly later asserted itself when he began to study at the college of Besançon. He took the degree of Bachelor of Letters there, was appointed a tutor, and in the intervals of his duties he studied to prepare himself for the École Normale. On his first examination he was admitted, having passed fourteenth on the list of candidates.

But this did not satisfy his ambition. He went to Paris, started on a new course of study in the Institution Barbet, and in 1845 tried the examination for a second time and won fourth place. He spent two years at the École in the study of chemistry, and was appointed a doctor in 1847. The following year he was appointed a professor of physics in the college at Dijon, and three months later was called to the University of Strassburg, where he was appointed professor of physics in the Faculty of Sciences. In 1854 he accomplished the organization of the newly formed Faculty of Sciences at Lille, and three years afterward he returned to Paris and assumed the "direction of the scientific studies" at the École Normale.

In 1865 he was made a professor of geology, physics, and chemistry, at the École des Beaux Arts, and in 1867, professor of chemistry at the Sorbonne, and he remained here until 1875. He was elected a member of the Academy of Sciences in 1862, and six years later, the faculty of medicine at Bonn gave him the title of Doctor, but he returned the diploma on account of the Franco-German war. In 1869 he was made a foreign member of the Royal Society of London, and in 1881 a member of the French Academy. The University of Oxford conferred on him the title of Doctor of Sciences, and he was made,

unanimously, a perpetual Secretary of the Academy of Sciences to replace Vulpian, who died in 1887; but the state of his health and his personal scientific researches did not allow him to assume the duties of the position. He resigned after two years, and was made an honorary perpetual Secretary.

He has received almost every distinction that the French Government could give him. By a decree of Napoleon III, not promulgated, he was made a Senator, and in 1885 became a member of the Legion of Honor, in which he was steadily promoted to the highest rank.

M. Pasteur began his well-known series of investigations with the study of crystals while he was an assistant in the École Normale. He had no allowance for the expenses of his studies, and so he worked in a laboratory of his own with no funds except what was supplied by his own slender resources. His success in this particular branch of inquiry was regarded as remarkable for so young a man, and it was only through the force of circumstances that his labors were led into another direction.

He began the study of fermentation when he became connected with the Faculty of Sciences at Lille. It was a subject little understood at that time, and he speedily succeeded in bringing the scientific men of France to agree with his conclusions.

In 1849 an epidemic threatened to destroy the entire silk worm industry of France. Pasteur went to Alais where the plague was raging in its worst form to see what scientific measures could be taken to abate it. His investigations there proved that the disease was contagious, and the simple method suggested by Pasteur to separate the diseased eggs from the healthy ones has since been adopted to prevent a recurrence of the epidemic.

The discoveries which were to make him best known were yet to follow. In 1870 he commenced his studies in inoculation for diseases other than small-pox, with which his name is most associated. He achieved some remarkable results in the prevention of hydrophobia. Patients from all parts of Europe and America travelled to Paris to put themselves under his care, and his treatment has long been given at Pasteur institutes established in London and New York.

The cholera epidemic of 1892 led him to begin experiments in anti-cholera vaccination which proved successful in the case of animals.

Pasteur was one of the greatest men of science of the present century, but in one respect he disappointed his admirers. His refusal to accept recognition from Germany appears to have been a mistake. Science is cosmopolitan, and the attempt to localize its rewards is inconsistent with the spirit of the age.

Marshall McDonald.—To his many friends, to the public having an interest in the fisheries which he labored so successfully to enrich, and to the biologists whose scientific labors he appreciated and utilized, the death of Colonel Marshall McDonald, the late U. S. Fish Commissioner, is a severe loss.

Though the work in which he was directly engaged in his official capacity was of an eminently practical nature, he early recognized that science was the ally of practice, or rather that the best practice is science, and sought in the working biologist his most helpful colaborer whom he always urged to turn to the solution of the problems which he had ever before him.

With Col. McDonald pisciculture in this country was fast advancing to the secure foundations of scientific method now enjoyed to a considerable degree by its sister art, agriculture. His method was not to experiment at hap-hazard in the hope of making a lucky hit that might solve the problem at hand, but by the most painstaking investigation to study the fisheries in their widest relations, to build up a firm basis of facts scientifically acquired, and from these to draw conclusions which were as practical as they were far-reaching and accurate. This method was necessarily as slow as its results are enduring, and we have yet to see the full fruition of his labors. As a consequence the work has met with the usual criticism from impatient persons of circumscribed view, who would measure the value of the Fish Commission's labors only by the number of young fry annually raised, or supposed to have been raised, failing to recognize the practical fact, which alone will appeal in such cases, that many of the methods and apparatus now generally employed in local hatcheries have resulted from the careful scientific inquiry conducted under Col. McDonald's direction, and without which the highly gratifying and useful results attained would not now be possible.

One of the last important works of Col. McDonald's life was to plan a biological and physical survey of far greater thoroughness than any previously undertaken. He was convinced that the first step toward a comprehensive knowledge of the conditions of greatest productiveness of the fisheries is an understanding of the primary food supply—the "aquatic pasturage," he called it. This he hoped to gain by an accurate qualitative and quantitative analysis of the unicellular plankton and littoral life, which, in turn, involves the chemico-biological and physico-biological questions concerning the ultimate relation existing between land waste and sea utilization, and incidentally a study of the life-histories and interrelations of myriads of animals and plants.

While busily engaged in thus establishing the foundations for the pisciculture of the future, he was ever alert to secure methods of immediate practical utility, and searched the scientific literature for facts and suggestions, and it was thus often through him that important biological work, which had else been barren of practical results, became the basis of inventions of much economic importance. His mechanical ingenuity was remarkable, as his numerous inventions of apparatus will testify; nor until ill-health forced him to relax his efforts did he neglect the minutest details of construction.

It is, of course, impossible, in such a short sketch, to give any adequate idea of the scope and importance of Col. McDonald's work, completed or contemplated, but I am sure that all who have a scientific grasp of the questions involved in the labors of the U. S. Fish Commission toward the maintainance and betterment of our extensive fisheries will feel the immense loss which these interests have sustained in the death of Col. McDonald, especially following so shortly upon that of his lamented co-worker and frequent scientific adviser, Dr. John A. Ryder.

Col. McDonald was born in Romney, Hamshire Co., W. Va., Oct. 18, 1836. His early education was had at a local academy. He entered the Virginia Military Institute in 1855 and graduated in 1860, having interrupted his course to attend the University of Virginia during the college year of 1858–59. After graduation he was appointed assistant at the Institute to Prof. "Stonewall" Jackson, serving until the outbreak of the war, when he was appointed Inspector-General on that General's staff. He saw much active service, particularly while serving as an officer of the Engineer Corps. From 1866 to 1879 he was a professor at his alma mater, occupying the chair of chemistry, geology and mineralogy, and later that of geology and mining engineering. He served as Commissioner of Fisheries of Virginia from 1875 to 1888, when he was appointed U. S. Commissioner by President Cleveland, to succeed Dr. G. Brown Goode, who had temporarily filled the position left vacant by the death of Prof. Baird. Col. McDonald had previously held responsible positions in the U. S. Fish Commission under Prof. Baird, first, in 1879, as special agent on the fisheries statistics for the Tenth Census, then as superintendent of the shad hatcheries of the Potomac River, and subsequently as chief of the Division of Distribution of Food-fishes. He died Sept. 1, 1895.

—J. PERCY MOORE.

Luigi Ferri, Professor of Philosophy in the University of Rome, Italy, died in Rome, March 17, 1895. He was born in Bologna in 1826,

was educated in France under Suisset and Simon, among his fellow pupils being E. Curo and Paul Janet. In 1862 he was made Professor of the History of Philosophy in the University of Florence and remained there until 1871, when he assumed the title of Professor of Theoretical Philosophy at Rome. His most important works were "Histoire de la Philosophie en Italie au XIX^{e} siècle," 1869, and "Psychologie de l'Association de Hobbes à nos jouès," but he was best known as the editor of Italy's chief philosophical journal, the "Revista Italiana di Filosofia."

Charles Secrétan, a pupil of the philosopher Schelling and for many years Professor of Philosophy in the University of Lausanne, died January 22, 1895.

G. G. Glogan, Professor in the University of Kiel and author of many psychological and philosophical works, died early in this year.

Dr. D. Hack Tuke, the distinguished alienist, author of many works on psychological medicine, died in London March 5, 1895.

Georg von Gicycki, Associate Professor of Philosophy in the University of Berlin, died March 4, 1895, at the age of 46. Professor von Gicycki was the leader of the Utilitarian school in Germany, was a warm personal friend of Felix Adler and Stanton Coit and was much interested in the introduction of the "Ethical Culture" movement into Germany. His most important work appeared in 1888 under the title "Moralphilosophie."

Appointments of the past year. Professor O. Külps, who has been one of Wundt's assistants at Leipzig has gone to the University of Würzburg.

Dr. S. Mezes, a graduate of Harvard, has been appointed Professor of Philosophy in the University of Texas.

Dr. Margaret Washburn to be Professor of Philosophy and Psychology at Wells College.

W. B. Elkin to be Professor of Philosophy in Colgate University.

A. H. Lloyd to be Assistant Professor of Philosophy, and J. Bigham Ph. D. (Harvard) and Geo. Rebec Ph. B. (Mich.) Instructors in Philosophy in the University of Michigan.

J. S. Mackenzie M. A. to be Professor of Philosophy in University College, Cardiff, Wales.

W. L. Bryan Ph. D. (Clarke) to be Professor of Philosophy and Vice-President, University of Indiana. Dr. John A. Bergstrom to be Assistant Professor of Psychology and Pedagogy; E. H. Lindley to be Instructor in Philosophy.

Warner Fite Ph. D. (Penna.) to be Instructor in Philosophy, Williams College.

J. H. Hyslop Ph. D. (Johns Hopkins) to be Professor of Logic and Ethics, Columbia College.

Dr. J. Allen Gilbert of Yale to be Assistant Professor of Psychology in the University of Iowa.

Drs. E. B. Titchenor and J. E. Creighton have been made full Professors in the Sage School of Philosophy at Cornell.

Dr. Hillebrand has been made Assistant Professor of Experimental Psychology in the University of Vienna.

Dr. Hugo Münsterberg, Professor of Experimental Psychology in Harvard University for the past three years, has returned to Germany. He has not yet decided whether he will make his home permanently in the United States or in Germany.

Report of the Committee Appointed by the Smithsonian Institution to Award the Hodgkins Fund Prizes.—The Committee of Award for the Hodgkins prizes of the Smithsonian Institution has completed its examination of the two hundred and eighteen papers submitted in competition by contestants.

The Committee is composed of the following members:

Dr. S. P. Langley, Chairman, *ex-officio;* Dr. G. Brown Goode, appointed by the Secretary of the Smithsonian Institution; Assistant Surgeon-General John S. Billings, by the President of the National Academy of Sciences; Professor M. W. Harrington, by the President of the American Association for the Advancement of Science.

The Foreign Advisory Committee, as first constituted, was represented by Monsieur J. Jansen, Professor T. H. Huxley, and Professor von Helmholtz; and after the recent loss of the latter, Dr. W. von Bezold was added. After consultation with these eminent men, the Committee decided as follows:

First prize, of ten thousand dollars, for a treatise embodying some new and important discoveries in regard to the nature or properties of atmospheric air, to Lord Rayleigh, of London, and Professor Wm. Ramsay, of the University College, London, for the discovery of *Argon*, a new element of the atmosphere.

The second prize, of two thousand dollars, is not awarded, owing to the failure of any contestant to comply strictly with the terms of the offer.

The third prize, of one thousand dollars, to Dr. Henry de Varigny, of Paris, for the best popular treatise upon atmospheric air, its properties and relationships. Dr. de Varginy's essay is entitled "L'Air et la Vie."

August 9, 1895. (Signed) S. P. LANGLEY,
G. BROWN GOODE,
JOHN S. BILLINGS,
M. W. HARRINGTON.

"Post-Darwinian Questions," the second part of the late Prof. George J. Romanes' work, "Darwin, and After Darwin," is announced for publication by the Open Court Publishing Company, of Chicago, on October 15th next. With the exception of the concluding chapters, the present volume was ready for publication over two years ago, but the severe and protracted illness of Professor Romanes prevented its speedy completion. On his death, in 1894, the manuscript was placed in the hands of his friend, Prof. C. Lloyd Morgan, the distinguished biologist and Principal of University College, Bristol, England, who has successfully edited the work. This volume, with the first on "The Darwinian Theory," and the booklet on "Weismannism," constitutes, in the opinion of all competent critics, the most complete and authoritative *general* treatise on evolution in the English language. (Pages, 334. Price, $1.50.)

The same publishing house has also recently issued a second edition of Professor Romanes' "Thoughts on Religion," declared, by a prominent writer in the Chicago *Tribune*, to be "one of the most valuable books the century has produced." (Pages, 184. Price, $1.25.)

The Open Court Publishing Co., of Chicago, will issue, late in October, one of the most important books on the theory of evolution which America, perhaps, has yet produced. Its author is Prof. E. D. Cope, of Philadelphia, a well-known representative of the Neo-Lamarckian school of America, and represents the opposite extreme to Weismannism in evolution. In this book, which is entitled "The Primary Factors of Organic Evolution," Professor Cope will seek to show, principally by an examination of the paleontological records (in which he has done his main original work), and secondarily by a review of the general results of embryology and comparative anatomy, what the *efficient causes* are that are concerned in the progressive development and per-

fection of the organic forms of the world. One of the most noteworthy features of the book will be Professor Cope's attempt to show that every variation of organic beings has been produced by a direct efficient cause, and is not the result of chance—a consideration which Darwin overlooked. Professor Cope also discusses the part which consciousness has played in the evolution of living forms. His book will be a storehouse of evolutionary facts and discussions, especially from the paleontological point of view and undoubtedly the most complete handbook of the *purely mechanical* theory of evolution which exists. The original illustrations will be numerous and valuable. (Pages, *circa* 550. Price, $2.00.)

Course in Embryology.—Professor Charles S. Minot will give, at the Harvard Medical School, Boston, a course intended for persons who wish to make a special study of vertebrate or human embryology. This course is open to registered students of the graduate department of the Faculty of Arts and Sciences, and will be offered hereafter also as a special course to graduate students of the medical school.

This course will extend through the entire year, but in two parts of one term each. The resources of the Embryological Laboratory in apparatus and material render it possible to offer unusually favorable opportunities for both general study and special research. The course is arranged for those who, as morphologists, anatomists and practitioners, wish to give the principal part of their time for one or more school terms to the subject. It will cover the whole field of embryology, including the genital products, the theories of heredity and sex, the formation of the germ-layers, differentiation of the organs, the history of the placenta and the general morphology of vertebrates and of man. Most of the work will be done by the student in the laboratory, but there will also be formal lectures. Students taking this course will be expected to devote to it not less than eighteen hours a week.

Persons wishing to take this course should enter the university as graduate students under the Faculty of Arts and Sciences, but those who have a medical degree may enter as graduate students of the medical school. In the latter case, the fee for one term is $75.00, for two terms $125.00.

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Prizes of the Belgian Academy of Sciences, Letters and Fine Arts.—The following announcement in regard to the prizes offered by the *Academie Royale des Sciences, des Lettres et des Beaux-*

Arts de Belgique has recently been made. In Natural Science the subjects for discussion are: (1). Original researches on the intervention of the phagocytes in the development of the invertebrates. (2). A description of the phosphates and carbonates of Belgian soil. The description must include the strata and locality of each mineral to which the writer refer. (3). Original researches concerning the peripheral nervous system of the Amphioxus, and, in particular, the constitution and genesis of the roots of the sensory nerves. (4). Original researches concerning the mechanism of the cicatrization of plants.

The prize for each of the four divisions will be a gold medal, valued at six hundred francs.

The memoirs must be written legibly, either in French or Flemish, and addressed post-paid to *M. le secretaire perpétual, au palais des Académies*, before the first of August, 1896.

The Academy insists upon exact citations; the authors must give the editions and pages of the works cited. Only manuscript copy will be accepted.

The competitors are requested not to use a pseudonym, but to adopt a device, which must be repeated on a card containing the name and address of the author and sent with the manuscript in a sealed envelope A prize cannot be awarded to any one who fails to comply with this formality.

All memoirs sent after the limit of time has expired, or those whose authorship is made known in any way whatever, are excluded from the competition.

The Academy reminds the competitors that when the memoirs are submitted for judgment, they must remain among its archives. However, the authors may have copies made at their own expense, by addressing a note to that effect to the permanent secretary.

The Jean Servais Stas prize is in the form of one thousand francs, to be awarded to the best work on the following subject:

To determine, by original research, the atomic weight of one or more elements for which the physical constant is now uncertain.

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